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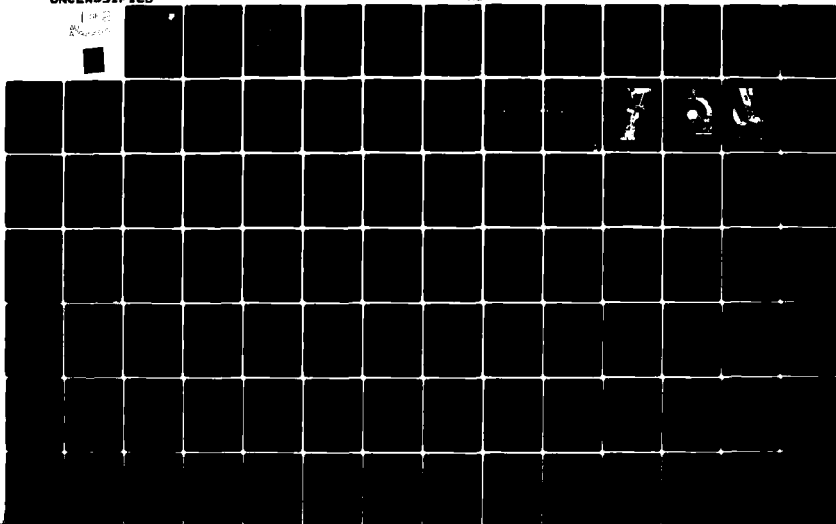
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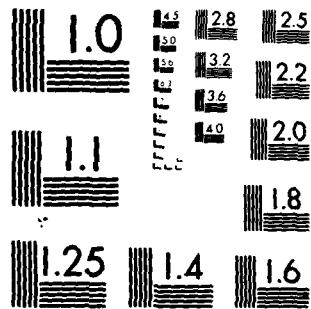
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Final Technical Report
August 1980

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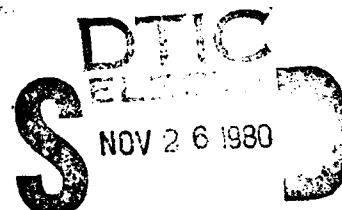
MILES PRESSURE/SEISMIC RESPONSE ENGINEERING DEVELOPMENT OF MILES TEST FIXTURE

Honeywell, Inc.

Kerry J. Sutherland
Thom R. Cavanagh

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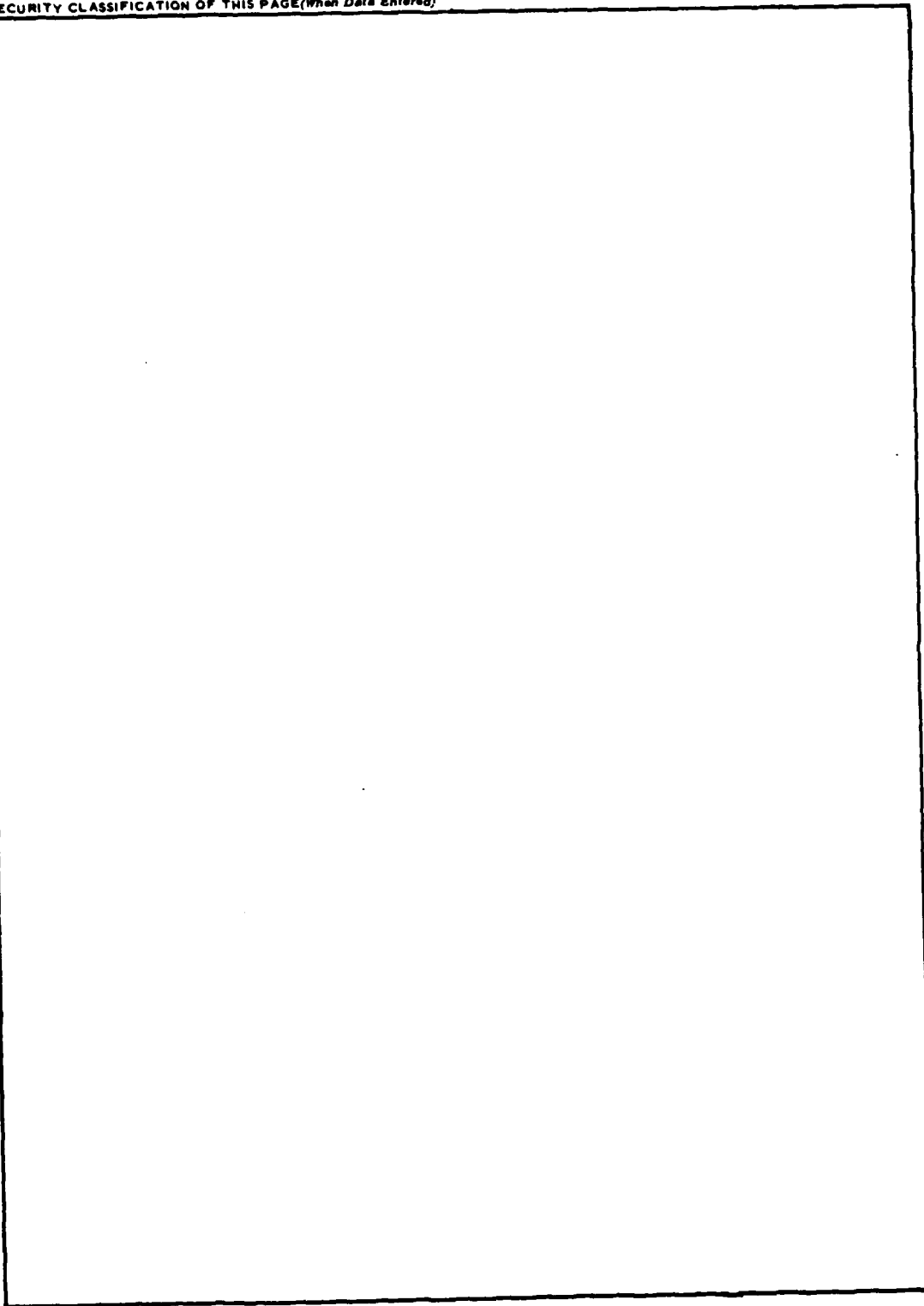
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TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
I INTRODUCTION	1
Background.	1
Purpose of Test Set	1
Description	2
II TEST SET DEVELOPMENT	3
General	3
Hardware Development.	3
Software Development.	3
Operational Verification.	4
Manual.	4
Chronological Development	4
III FINAL TEST SET CONFIGURATION	8
Test Item	8
Test Definition	8
Test Set.	9
Console Subassemblies	9
Tester Subassemblies.	15
Summary of Characteristics.	18
IV PRINCIPLES OF OPERATION.	21
Test Principles	21
Functional Interface.	21
MILES Transducer Interface.	24
Tester Interface.	27
Input Data Selection.	32
V TEST SET VERIFICATION.	35
Purpose	35
Verification Testing.	35
Results	35
Conclusions	35
VI REFERENCES	36
APPENDIX A Auto Test Flow Chart	37
APPENDIX B Auto Test Program Listing.	45
APPENDIX C Preamp Calibration Program Listing	55

TABLE OF CONTENTS
(Continued)

<u>SECTION</u>	<u>PAGE</u>
APPENDIX D Functional Test Program Listing	57
APPENDIX E Schematics.	67
ATTACHMENT 1.	78
ATTACHMENT 2.	123

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LIST OF ILLUSTRATIONS

<u>FIGURE NO.</u>	<u>TITLE</u>	<u>PAGE</u>
1	Equipment Location Diagram	10
2	Test Set Final Configuration	11
3	Test Chamber	12
4	Center Clamp and Modulation Mechanism.	13
5	Test Set Functional Interface.	22
6	Scanner Relay Boards	23
7	MILES Transducer Interface, Simplified Functional Diagram	26
8	Null Detection Waveforms	28
9	Tester Interface, Simplified Functional Diagram.	29
10	Field Magnetization Curve.	31
11	Interface Signals.	33
12	Input Data Selection	34
A-1	Auto Test Program Flow Chart (6 sheets).	38 - 43
A-2	Definition of Symbols.	44
E-1	System Interconnect Diagram.	68
E-2	Preamp Schematic	69
E-3	Power Supply Filter Schematic.	70
E-4	Amplifier, MUX, Null Detector Schematic	71
E-5	MILES Transducer Interface Interconnection Diagram . . .	72
E-6	Oscillators, A2 Board Schematic.	73
E-7	Coil Drivers, A1 Board Schematic	74
E-8	Length Measurement Circuit, A4 Board Schematic	75
E-9	Correlation Reference Circuit, A10 Board Schematic . . .	76
E-10	Correlator, A9 Board Schematic	77

LIST OF TABLES

<u>TABLE NO.</u>	<u>TITLE</u>	<u>PAGE</u>
1	Size and Weight	18
2	Center-to-Center Measurements	19
3	Differences in Models	19
4	Operational Requirements.	19
5	Test Conditions	20
6	Test Specifications	20
7	Control Channels.	25

SUMMARY

The TS-3753/U Transducer Test Set was developed to test Motional Pickup Transducer TR-299/G, commonly called the MILES Transducer. The transducer is a buried line system employed in security systems in the form of a cable. It is stored on a reel.

The test set handles the storage reel, transports the cable through a test chamber to a takeup reel, and automatically (under computer control) tests the cable and assimilates the test data. Start, stop, and control instructions are entered via a computer keyboard. The test operator can select the points on the cable to be tested, but is relieved of the chore of step-by-step direction.

During Phase III of this developmental effort, the basic test chamber was modified, the operator console was developed, and software test programs were developed.

At the conclusion of Phase III, the system was operationally tested. The results of the tests clearly indicate that the test set provides an effective means of testing the MILES transducer.

EVALUATION

The development of Transducer Test Set TS-3753/U, referred to as the MILES test fixture or test fixture, marks the first time that the Air Force has the capability of measuring the in-factory seismic and magnetic sensitivities of Motion Pickup Transducer TR-299/G, commonly called the MILES cable. Data acquired with the test fixture will allow the Air Force to more effectively monitor the manufactured quality of the MILES cable; will provide additional insight into explaining performance anomalies observed with some of the MILES operating in the field; and will permit predicting MILES performance in the field when combined with certain parameters of the actual site of its deployment. These capabilities all enhance the more effective use of the MILES cable in achieving the detection requirements for fixed installation security systems as outlined in TPO R6A. Two engineering development models of the test fixture were procured. One will be retained by AFLC to support continued procurement and deployment of the MILES. The disposition of the second fixture has not been established; however, it may be retained at an R&D facility to support any additional test and development conducted on the MILES cable.



ROBERT B. CURTIS
Project Engineer

SECTION I

INTRODUCTION

This final report covers the work accomplished under Phase III of Contract F30602-76-C-0385 for development of a test device for use in in-factory testing of the MILES transducer. The project was performed under direction of Rome Air Development Center (RADC). The contract period extended from 12 April 1979 to 31 March 1980.

During Phase III, two working systems were designed, built, and delivered. The system nomenclature is Transducer Test Set TS-3753/U.

BACKGROUND

The MILES transducer provides an effective means for intrusion detection in perimeter security systems. The transducer is essentially a cable, 100 meters in length, that is usually buried at a depth of nine inches, but may be buried as deep as eighteen inches. The transducer core is a permalloy material possessing high permeability and magnetostrictive properties. A sense winding is wrapped about the core. The winding direction is reversed periodically to provide a gradiometer configuration that results in rejection of far-field disturbances. By virtue of the high permeability of the core, the transducer is sensitive to anomalies produced within the earth's magnetic field as, for example, by an armed intruder. The magnetostrictive properties of the core material make the transducer sensitive to the small soil displacements (pressure/seismic) caused by the passage of an intruder.

The MILES transducer has been widely deployed in a "round" configuration in which the core is a stranded bundle of permalloy material, and an outer layer of thermoplastic material provides a protective covering.

Although MILES transducers have been used successfully in security systems, variations in sensitivity have been observed. The cause of these variations may be either the burial environment or the specific transducer characteristics. Prior to the development of this test set, no information or technique was available for assessing either the magnetic or pressure/seismic sensitivity. Consequently, little or no guidance could be provided to assist in the optimization of a specific installation or the correction of performance anomalies.

The test set provides a solution to this problem. It provides the means to make in-factory measurements of the magnetic and pressure/seismic sensitivity of MILES transducers. The use of this test set will assure satisfactory transducer performance before its installation in a security system.

PURPOSE OF THE TEST SET

The test set measures the following parameters of the transducer:

1. DC Resistance
2. Winding-to-Shield Insulation Resistance

3. Magnetic Sensitivity at Any Point Along the Cable*
4. Pressure Sensitivity at Any Point Along the Cable*
5. Distance Between Transpositions

It contains a cable transport for positioning the desired portion of the cable in the test assembly.

DESCRIPTION

The test set consists of two major parts: the test device and the operator console.

The test device contains the necessary mechanical, pneumatic, and electrical apparatus to physically perform the tests and to position the cable. Cable positioning is done by transferring the cable from the supply or shipping reel to a takeup reel. In moving from one reel to the other, the cable passes through a test chamber. The cable is stopped at the desired point on the cable and tested in the test chamber. Testing the magnetostrictive characteristics requires clamping the cable at a transposition and applying a 1 Hz mechanical perturbation. The cable also passes through a set of large coils which are used to test the magnetic properties of the cable. Several DC resistance checks are made via the connector on the leading end of the cable.

The operator console supervises testing, issues commands to the test device, and gathers and analyzes tests results data. The heart of the console is a Hewlett-Packard 9825 computer. The software program of the computer directs automatic testing of the transducer and supplies the operator with program options. The operator is relieved of the burden of issuing commands such as activating pistons, closing switches, and turning drive motors on and off. The computer issues these commands. The console also records all test data, compares them with preset limits, and makes the determinations of whether the tests results are good or bad.

For a more detailed discussion of the theory of operation, refer to the Transducer Test Set TS-3753/U Operation and Maintenance Manual dated May 1980. The physical description of the test set in its final form is given in Section III of this document.

* Except for a few feet at each end of cable.

SECTION II

TEST SET DEVELOPMENT

GENERAL

The advanced development test fixture was developed during Phase II of the contract to demonstrate that the desired parameters could be measured with repeatable results. Therefore, to determine the state of development of the test fixture at the start of Phase III, refer to the Final Technical Report of Phase II RADC-TR-79-157 dated June 1979.

HARDWARE DEVELOPMENT

Hardware development during Phase III consisted of:

1. Upgrading the Phase II test fixture so that it could be tied to a controller or data acquisition system.
2. Improving deficiencies previously discovered or discovered during Phase III.
3. Development of a data acquisition and sequence control system to automatically, under computer control, run tests, gather test data, and analyze test results.
4. Fabricate a second automated test fixture.

SOFTWARE DEVELOPMENT

Software development consisted of:

1. Developing a program (Auto Test) for the Hewlett-Packard 3052A Data Acquisition System. This program, among other things, issues commands to move the Unit Under Test (UUT), clamp and test the UUT, and to record and reduce the measured data.
2. Development of a program to calibrate the preamplifier gain. Since the preamplifier circuits contained relays which were under computer control, it was more practical to write a program to calibrate the preamplifier than to write procedures for manual calibration.
3. Development of a program to check the overall calibration of the test set. The Functional Test Program is used to test a standard transducer of known characteristics. The results are compared to the results of the same tests run earlier on the same transducer. If the results are comparable, the test set is considered to be in proper calibration. If the results are different, the test set requires manual calibration.

The Functional Test Program is a slightly modified version of the Auto Test Program (Item 1 above). The major differences are:

- a) Operator selection of the manual test transposition mode is not allowed, and
- b) Tighter limits have been placed on the allowable variation in standard deviation and mean of the pressure/seismic, magnetic sensitivity, and distance between transpositions data.

OPERATIONAL VERIFICATION

Successful operation of the completed system was demonstrated during verification testing. This is discussed in Section V of this document.

MANUAL

An operator and maintenance manual was developed during Phase III. This manual gives instructions on how to use the system programs, how to manually calibrate the system, and how to modify the system software. It also provides the theory of operation and includes a parts list.

CHRONOLOGICAL DEVELOPMENT

The Phase III contract period was from 12 April 1979 to 31 March 1980. The developmental chronology is given here on a month-by-month basis as reported in the project monthly progress reports.

May 1979

1. Stroke of cable clamp was increased to permit easier threading of cable. At the same time the clamp arms were given more lateral stability.
2. The decision was made to mount reels and test assembly on a common base to provide stability and repeatability.
3. Definition of the reel assemblies was begun. This included:
 - a) A DC generator drive of 1/8 to 1/4 hp for use in conjunction with a controller which would respond to a 1-10 volt input. Reel speeds would be 0.4 to 12 rpm's yielding cable speeds of 1/2 in/sec in forward mode and 16 1/2 in/sec in the rewind mode.
 - b) Clutch between motor drive and reel.
 - c) Friction brake to prevent overshoot.
 - d) Preamplifier and null detector circuitry mounted directly on take-up reel.
 - e) Sliprings for preamplifier signals. Long life sliprings will be used and to further lengthen their life, two sets of sliprings will be used for high current signals.
 - f) Level winder device driven by assembly to eliminate sharp kinks

and high stresses in cable due to overlapping strands when cable is wound on reel under tension.

g) Pulse generator for cable length measurement.

4. A need was recognized for a device to position the oscillating clamp to provide a symmetrical stress on the UUT.
5. It was decided to eliminate the straightening rollers. The rollers put undue stress on the cable.

June 1979

1. It was decided that the 19" rack mount used to house the custom electronics boards for Phase II would be mounted in the H-P data acquisition cabinet for Phase III. This modified H-P cabinet will be called the console.

July 1979

1. The 1 Hz magnetic oscillator and the 16 Hz null detector oscillator have been designed and built.
2. The length and null detector circuits have been designed.
3. It was decided that the overall length of the test set would probably have to be increased from 20 feet to 22 feet. This is to reduce the angle of incidence of the cable between the transducer and center line of the test set.
4. Due to the mechanical dimensions, it became apparent that, with or without lengthening the test stand, the first transposition could not be tested under automatic control. The distance from the test stand to the take-up reel would not allow it.

August 1979

1. Drawings for parts to correct mechanical deficiencies were completed, including drawings for the mounting bases, modified clamping arrangement, and redesign of the force arm bearings.
2. The design for the power distribution and pneumatic valves/solenoids was completed.
3. The magnetic excitation oscillator, nulling oscillator, and length measurement circuits were built.

September 1979

1. The two Hewlett Packard 3052 Data Acquisition Systems were received.

October 1979

1. The eight custom electronic circuit boards were fabricated and debugged.
2. The HP 3052 Data Acquisition System was installed and checked out.
3. Completed 90% of the interface wiring between custom electronics and the data acquisition system.
4. The software initialization, functional test, and direct current resistance/insulation resistance measurement programs have been coded.

November 1979

1. All electronic and mechanical parts except the limit switch have been received.
2. Total software concept completed and reviewed.

December 1979

1. The mechanical test device for unit #1 has been completely assembled.
2. Problems requiring modifications include:
 - a) The wind dimensions of the level winder rollers must be decreased. This will eliminate bunching of the cable on the ends of the reels.
 - b) The clamp design will require further modifications to prevent occasional misclamping.
 - c) The supply reel limit switch mounting will have to be modified.
3. The software Automatic Test Program is operational and being debugged.

January 1980

1. All necessary modifications identified during system integration have been designed and necessary parts have been ordered.
2. The Preamplifier Calibration Program has been written and debugged. This program uses the high speed sampling voltmeter to check pre-amplifier calibration.
3. The Functional Test Program is being written. This program will be used to test system calibration.

February 1980

1. The Automatic Test Program is complete except for entering the test limits.
2. The Functional Test Program has been reviewed.
3. Draft copies of the tester Maintenance Manual were submitted.

March 1980

1. The Auto Test Program was completed and parameter limits selected.
2. The Functional Test Program was completed. The parameter limits will be selected during on-site calibration of Unit #001.
3. Acceptance Test Procedure was completed.

SECTION III

FINAL TEST SET CONFIGURATION

TEST ITEM

The test item is a magnetic and magnetostrictive transducer in the form of a cable. Its title is Motional Pickup Transducer TR-229/G. It consists of a core of stranded magnetostrictive wire, which is insulated. Around the insulation is a sense winding, and the coil direction of the winding reverses every 43 inches. The change is called a transposition. Insulation covers this winding, and over the insulation is a silver-copper braid shield. Finally, a plastic jacket covers the shield. This composition forms a cable, which comes in lengths of 337 feet. The cable is 1/2 inch in diameter and weighs 70 pounds. A wooden reel, which is 3 feet in diameter and 1 foot wide, holds the cable and weighs 125 pounds when loaded. The test item terminates in a Bendix QDP 06 SW10-995 connector, which is P8 in this system. Connector contact C is the shield connection; contacts A and B are the signal and return end of the sense winding. The sense winding returns electrically through the core, so that contact B is connected to the core. The output from contact A is the sensor output.

As a functional device, the test item is referred to as a MILES transducer. Its form and handling characteristics are those of a cable; hence, it is the MILES cable. As a generalized test item, it is the unit under test, sometimes abbreviated UUT.

TEST DEFINITION

Acceptability of a MILES transducer depends on the results of five tests. These tests measure:

- Resistance of the sense winding.
- Resistance of the insulation between the sense winding and the shield.
- Distance between sense winding transpositions.
- Response to a controlled mechanical disturbance.
- Response to a controlled disturbance in the magnetic field surrounding the unit under test.

The mechanical disturbance is the result of a time varying force applied as a controlled stress along the length of selected sample sections of the MILES transducer. Each sample section spans about 86 inches, where a sense winding transposition occurs in the center and at each end of the sample. The controlled force, which is superimposed on a bias tension of 10 pounds, varies sinusoidally with an amplitude of 1.4 pound at a frequency of 1 hertz. The magnetic disturbance is the result of a controlled sinusoidal variation, with an amplitude of 100 gamma, in a magnetic field that is biased to the positive knee of the MILES transducer's hysteresis curve. The magnetic bias includes

the effect of the earth's magnetic field. The combined magnetizing force is 0.25 oersted. In each case, a varying voltage on the sense winding reflects the disturbance.

An automatic data reduction routine uses the data generated by the tests to calculate and printout the mean and standard deviation of the mechanical disturbance response, the magnetic disturbance response, and the distance between transpositions. The data output also includes the number of transposition tested and the number of test failures.

TEST SET

The test set, which is illustrated in Figures 1 through 4, is comprised of two subsystems: a console and a tester. The console is a cabinet of rack mounted electronic equipment. This equipment implements the automatic test control, data acquisition, and data reduction capabilities of the test set. An interactive program controls the operation of the console. Through a computer on the console, the operator initiates each test, monitors the results, and has the option to repeat any test that fails. The operator also has the option to assign control to the program. The tester consists of three major assemblies: a supply-rewind assembly that holds the unit under test, a test chamber assembly, and a takeup/advance assembly.

CONSOLE SUBASSEMBLIES

The console includes a computer and a cabinet of rack mounted equipment that includes a multimeter, a voltmeter, a digital-to-analog converter, and a channel multiplexer. This equipment forms a modified version of the Hewlett-Packard 3052A Data Acquisition System. The cabinet also contains power supplies and special electronic equipment for controlling the tester and for processing signals from the tester.

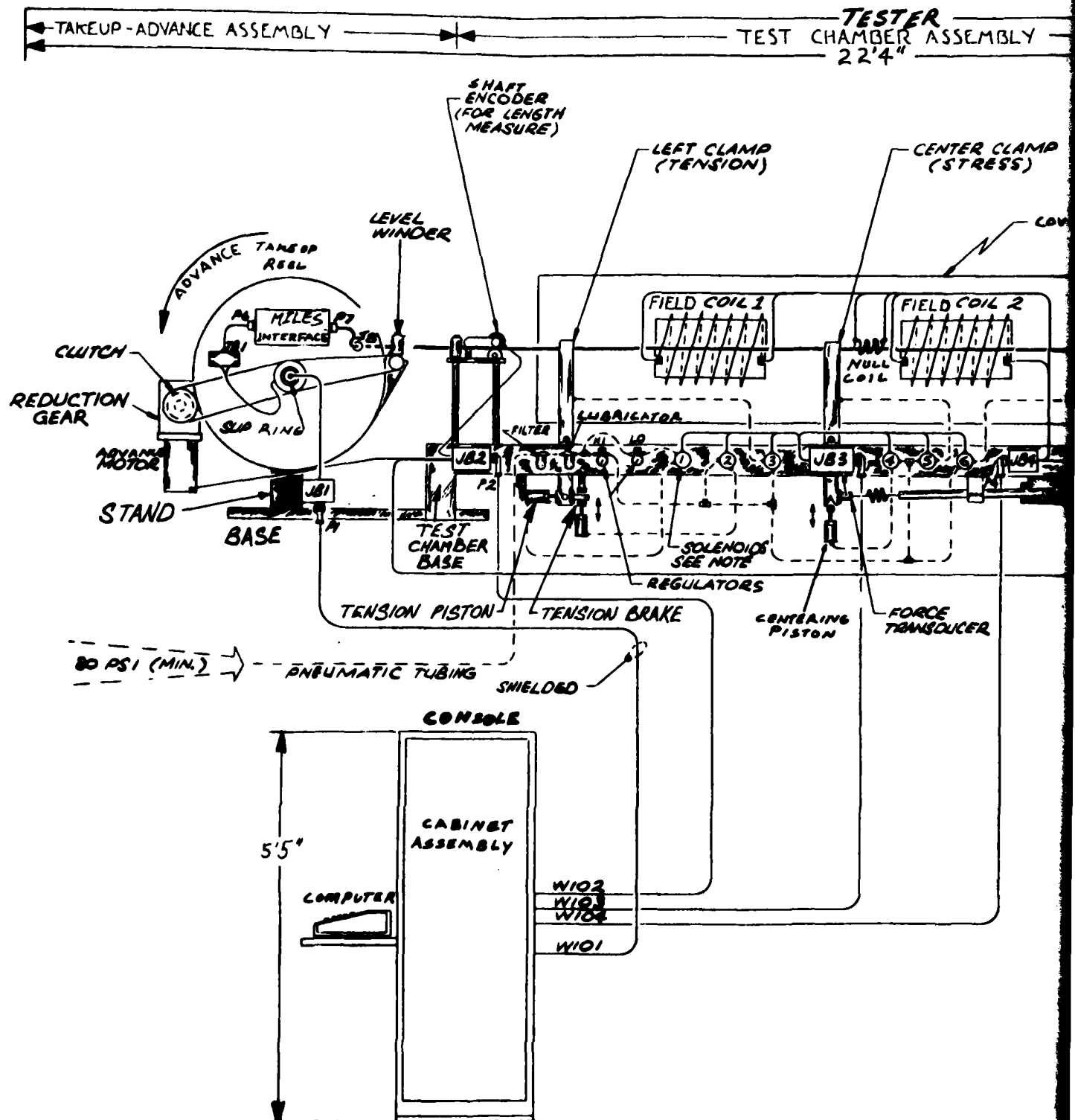
The following paragraphs identify each of the subassemblies in the console.

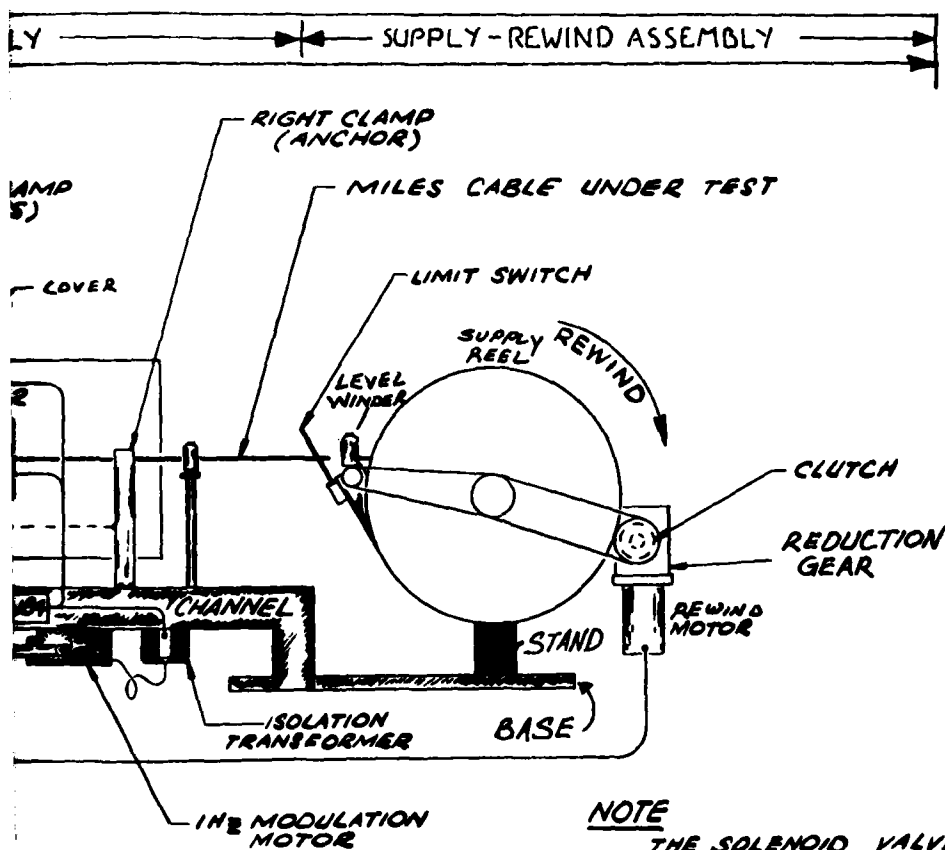
The following options define the Hewlett-Packard modification to their standard 3052A system for the test set.

<u>Option</u>	<u>Effect</u>
210	Add 98035A Real-Time Interface
D92	Replace Fast Scanning Control Board with Standard Control Board (deletes option 100)
R20	Add Shelf 12675 to Cabinet
D55	Delete Digital Voltmeter 3455A
M22	Add Digital Voltmeter 3438A
S21	Add Digital-to-Analog Converter 59501A

Cabinet

The cabinet is the HP 29402B. The cabinet is strapped for 120 volts, 60 hertz, single phase, 2-wire plus ground.





NOTE

THE SOLENOID VALVES FOR ALL CLAMPS
AND MECHANICAL ACTIONS:

- 1 TENSION CONTROL
- 2 TENSION BRAKE
- 3 TENSION CLAMP
- 4 CENTERING PISTON
- 5 STRESS CLAMP
- 6 ANCHOR CLAMP

Figure 1. Equipment Location Diagram

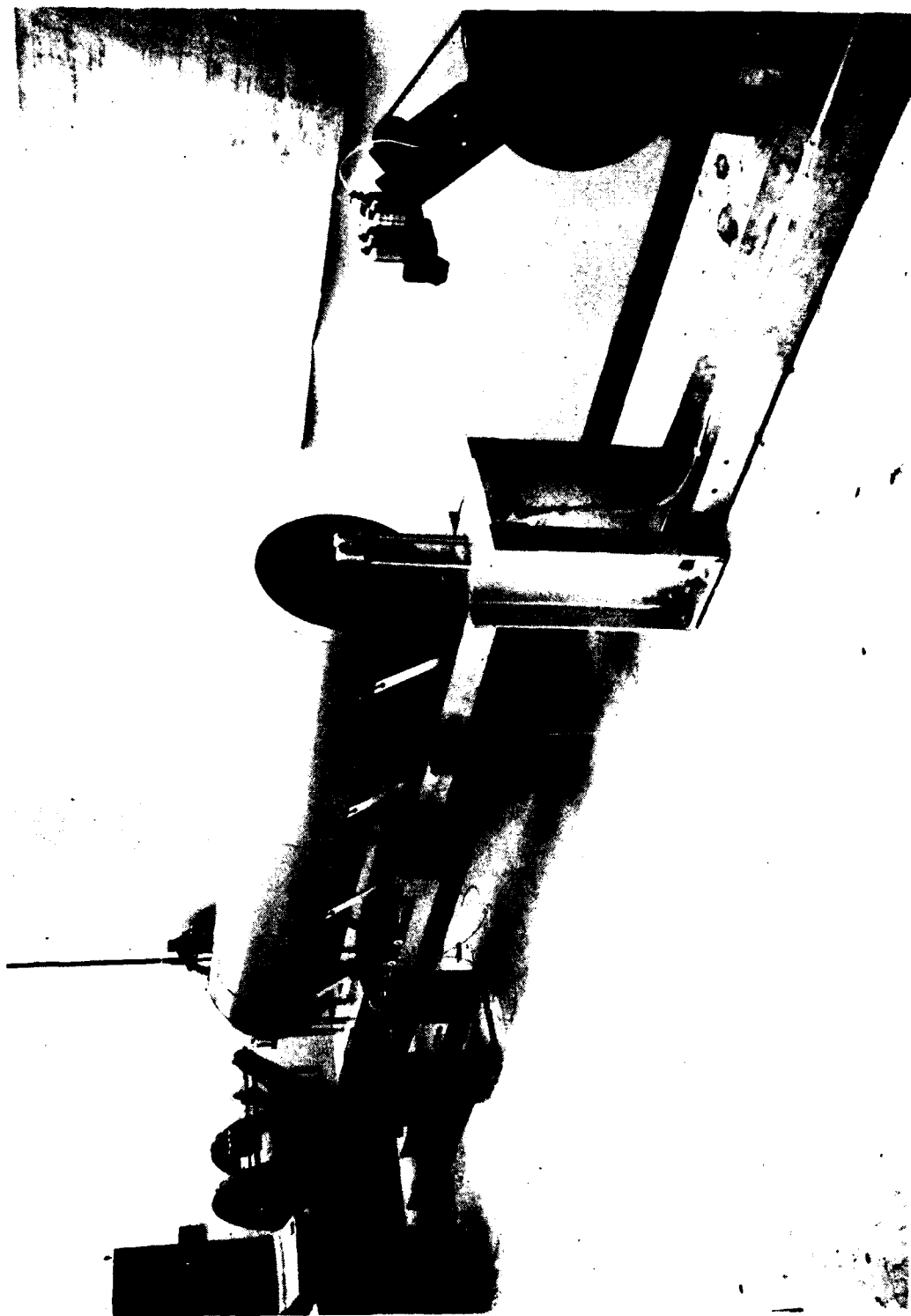


Figure 2. Test Set Final Configuration

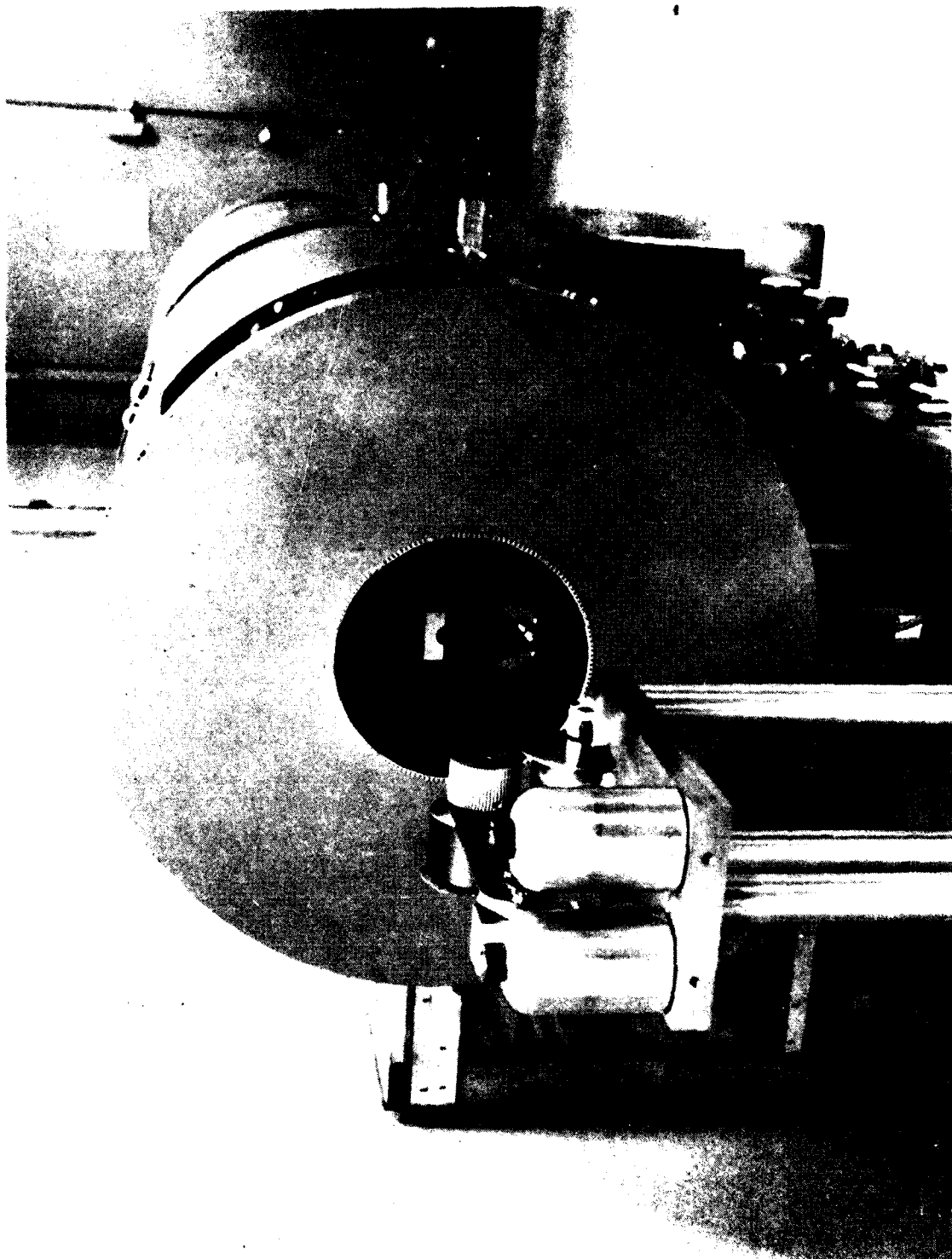


Figure 3. Test Chamber

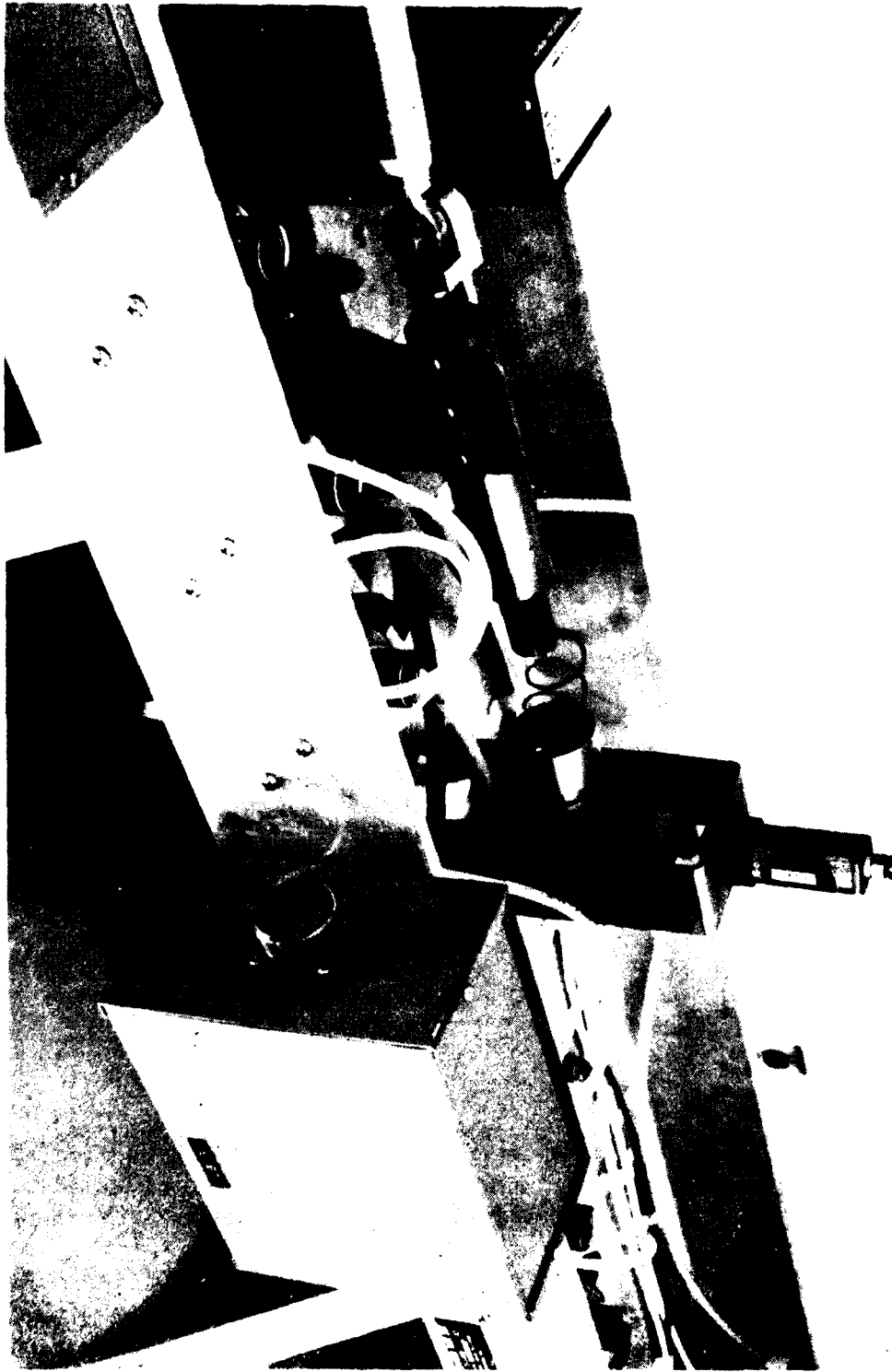


Figure 4. Center Clamp and Modulation Mechanism

Computer

The computer is the HP 9825A Programmable Calculator. It is called a calculator, controller, or computer, depending upon its application. In the test set, it is a computer. It has keyboard and tape cartridge input and LED display and strip printer output. Interconnecting the computer and the other HP units is a Hewlett-Packard interface bus, the 98034A HP-1B Interface. The HP-1B interface includes a circuit board and a bus cable that connect to each unit. Real-Time Clock HP 98035A gives the computer real-time referencing and time related control capability. In the test set, the computer controls the test sequence, data acquisition, data reduction, and functional test routines. Operational and functional test programs recorded on tape cartridges for the computer are as follows:

<u>Program</u>	<u>Cartridge</u>
Auto Test	HW 27600189
Functional Test (File 0) and Preamp Calibration (File 1)	HW 27600190
3052A System Verification	HP 03052-90011
3052A Applications	HP 03052-90012
9825A System Test	HP 09825-90036
9825A General Utility Routines	HP 09825-10004

Multimeter (DMM)

The HP 3438A is a digital readout, five-function multimeter. In the test set, the DMM measures resistance of the sense winding and the insulation resistance of the unit under test. It also measures the resistance of the slip rings in the same circuit. This DMM is a low voltage potential instrument with a maximum resistance range capability of 19.9 megohms. Therefore, the 100 megohm at 500 \pm 5 volts DC specified by the Transducer, Motional Pickup TR-299/G() Specification cannot be verified with this test set. However, the 100 megohm, high voltage potential requirement should be construed as a qualification requirement, not an acceptance test requirement. In fact, the high voltage potential test can quite often damage the unit by weakening the insulation. Also, since the DC resistance of the transducer is on the order of 200 ohms, an insulation resistance in excess of 20 megohms would result in less than 0.01% transducer signal attenuation.

Voltmeter (SVM)

The HP 3437A SVM is a microprocessor controlled, digital readout, successive approximation voltmeter. In the test set, the SVM measures the output of the preamplifier, the velocity and length measurement circuits, the transposition null indicator circuit, and the correlator.

Digital-to-Analog Converter

The HP 59501A D/A Power Supply Programmer is a digital-to-analog converter that supplies an analog output voltage that is proportional to a digital input signal. The programmable output range is 1 volt or 10 volts. Each range is unipolar (0 to 0.999 or 0 to 9.99 volts) or bipolar (-1 to 0.998 or -10 to

9.98 volts). The test set uses the 0 to 9.99-volt range. The output goes to the control unit that controls the speed of the advance or rewind motor on the reel assemblies.

Scanner

The HP 3495A Scanner is a channel selector with a display that indicates the selected channel. The scanner configuration in this system has 30 actuator channels (option 002) and 20 low thermal channels (option 004). Not all of these are used. Selecting a channel consists of closing a reed relay contact.

The low thermal channels form a 20-to-1 multiplexer with one set of common terminals. Signals are multiplexed to the common terminals one at a time in a break-before-make sequence. Actuator channels are not sequenced, and any number of channels per decade may be selected at the same time. Six of the low thermal channels in this system select data for acquisition in a programmed sequence. Twenty-six actuator channels modify the control and data acquisition circuits, as directed by the program.

Power Supplies

There are four supplies in the cabinet: two bipolar 15-volt, 3-ampere supplies (HP dual output 62215E), one 5-volt, 2-ampere supply (Analog Devices 956), and either a 30-volt, 5-ampere supply (HP 62215G) or a 28-volt, 1.3-ampere supply (LAMBDA LM-B28).

Motor Speed Control

Paratrol S, which is made by Parametrics, is a DC motor speed control device. This device controls the speed of either of the reel drive motors in accordance with the output of the digital-to-analog converter.

Circuit Boards

A board rack, which is mounted between the scanner and the power supplies, holds the following circuit boards:

- A1 Field Coil Drivers
- A2 Oscillators
- A4 Length Measurement Circuit
- A9 Correlator
- A10 Correlation Reference Circuit

TESTER SUBASSEMBLIES

The following paragraphs identify the subassemblies of each of the major assemblies in the tester. Figure 1 illustrates these subassemblies.

Supply-Rewind Assembly

1. Base. The base is an aluminum channel 0.3-inch thick, 1 foot wide, and 3½ inches high. It bolts to a 26-inch leg of the test chamber base and to the stand.

2. Stand. The stand supports the following subassemblies.
3. Supply Reel. The supply reel holds the unit under test.
4. Rewind Motor. The rewind motor, also designated motor 2, is a $\frac{1}{4}$ horsepower, DC, PM motor that rewinds the unit under test.
5. Reduction Gear. The reduction gear provides a motor speed reduction of 40-to-1.
6. Clutch. The electromagnetic clutch engages the motor drive to the reel.
7. Brake. The manual friction brake applies enough drag to keep the reel from freewheeling. The brake, which is not shown, is located in the reduction gear assembly.
8. Level Winder. The level winder distributes the MILES cable on the reel.
9. Limit Switch. A microswitch mounted on the level winder detects the end of the MILES cable if the cable comes loose from the supply reel. The limit switch interrupts the advance motor.

Takeup-Advance Assembly

NOTE

Subassemblies (below) which are followed by an asterisk (*) are equivalent to the sequentially corresponding item in the supply-rewind assembly (above).

1. Base. *
2. Stand. *
3. Takeup Reel. The takeup reel, which is a permanent part of this assembly, holds the unit under test as it comes through the test chamber.
4. Advance Motor. The advance motor, also designated motor 1, is a $\frac{1}{4}$ horsepower, DC, PM motor that advances the unit under test from the supply reel to the takeup reel.
5. Reduction Gear. *
6. Clutch. *
7. Brake. *
8. Level Winder. *

9. Connector. Connector J8 is the interface between the unit under test and the test circuits.
10. MILES Transducer Interface. The MILES transducer interface includes a shielded preamplifier circuit board; an amplifier, multiplexer, and null detector circuit boards; and a power supply and filter circuit board. A metal box mounted on the reel contains this entire subassembly, including the unit under test interface connector J7 and the slip ring interface connector J6. This unit is labeled MILES Interface in Figure 1.
11. Slip Ring. The slip ring connects the MILES transducer interface, which revolves with the reel, to junction box 1, which remains stationary.
12. Junction Box 1 (JB1). Junction box 1 is the interface between the slip ring and cable W101. The cable connects the assembly electrically to the console.

Test Chamber Assembly

1. Base. The base is an aluminum channel, with the flat side up. It is 1 foot wide, $3\frac{1}{2}$ inches high, and 11 feet long. It supports the remaining subassemblies and bolts to reel assembly bases through a 26-inch leg at each end.
2. Cover. The cover is an iron tubular shield, 2 feet in diameter and 11 feet long. Three openings along the front of the cover provide access to the clamp assemblies.
3. Junction Boxes. Junction boxes 2, 3, and 4 (JB2, 3, 4) on the front of the base terminate cables W102, W103, and W104 from the console.
4. Null Coil. The null coil, which consists of 280 turns of 20-gauge magnet wire wound on a 3-inch diameter form, detects sense winding transpositions.
5. Field Coils. Two field coils, each of which consists of 460 turns of 14-gauge magnet wire on a tubular form 1 foot in diameter and 34 inches long, establish the magnetic field around the unit under test.
6. Length Measurer. The length measurer includes a shaft encoder with a spring loaded wheel that rests on the unit under test. The shaft encoder generates 100 pulses for each inch that the unit under test moves past the wheel.
7. Modulation Motor. The modulation motor, which is also designated motor 3 or the 1-Hz motor, is a $1/8$ horsepower universal motor that turns a reduction gear 60 revolutions per minute (1 hertz). Mechanically linked through a force transducer to the stress clamp assembly, the motor supplies the 1-Hz oscillating force that physically stresses the unit under test.

8. Isolation Transformer. The isolation transformer prevents line fluctuations from affecting the 1-Hz motor.
9. Force Transducer. The force transducer links the 1-Hz motor and the stress clamp assembly. The force transducer provides an output voltage that is proportional to the stress imposed on the unit under test and in phase with that stress. This voltage becomes the reference signal that is cross-correlated with the output of the preamp.
10. Pneumatic System. The pneumatic system includes an input hose, a connector, a moisture filter, a lubricator, two pressure regulators, six solenoid valves and cylinders, three cable clamps, a tension piston, and a centering piston. Supplied with compressed air at 80 to 90 psi, a high pressure regulator reduces the pressure to 60 psi to drive the cylinders that apply force to the cable clamps and to the centering piston. A low pressure regulator reduces the pressure to 31 psi to drive the cylinder that applies force to the UUT. In response to signals from the console, the solenoid valves control the pneumatic drive to the cylinders. An anchor clamp holds the unit under test on the right (the supply reel side). A tension clamp holds the unit under test on the left, the tension cylinder applies a 10-pound pull against the anchor clamp, and the tension brake holds the tension clamp in position to maintain the tension. The centering piston centers the stress clamp, which then clamps the unit under test in the center.

SUMMARY OF CHARACTERISTICS

Tables 1 through 6 summarize in separate categories characteristics of the test set, as related to installation and operation.

Table 1. Size and Weight

Assembly	Weight (pounds)	Dimensions (inches)		
		Length	Width	Height
Overall Test System				
Cable Handler-Model 1	1258	268	31	53
Cable Handler-Model 2	1263	268	29	51
Console	328	45	21	65
Test Chamber (Incl. Stand)				
Model 1	434	132	24	53
Model 2	429	132	20	51
Supply-Rewind (with full reel)	443	80	29	46
Supply Reel (loaded)	125	36*	12	46**
Advance-Takeup (with empty reel)	381	80	32	46
Computer	26	20	15	5.3

* Diameter

** Mounted

Table 2. Center-To-Center Measurements

From	To	Distance (inches)
Supply Reel	Anchor Clamp	65.5
Takeup Reel	Tension Clamp (Relaxed)	80
Limit Switch	Anchor Clamp	48
Stress Clamp	Null Coil	2
Stress Clamp	Anchor Clamp	43
Stress Clamp	Tension Clamp (Relaxed)	42
Tension Clamp (Relaxed)	Length Measurer	14

Table 3. Differences in Models

Model	Power Supply 4	Test Chamber Cover	
		Diameter (inches)	Length (inches)
1	30 vdc (HP 62215G)	24	96
2	28 vdc (LM-B28)	20	92

Table 4. Operational Requirements

Power Input	2.5 kilowatts, maximum; 120 volts, -10 percent, +5 percent, 60 hertz, single phase
Compressed Air	85 \pm 5 pounds per square inch, 5 SCFM
Temperature	13 to 33 degrees C
Relative Humidity	80 percent, maximum

Table 5. Test Conditions

Null Coil Excitation	100 hertz
Magnetic Field dc Bias	
Pretest	+ 10 oersteds
Test	+ 0.25 oersted
Magnetic Field Excitation	100 gamma peak at 1 hertz
Mechanical Stress Bias	10 pounds
Mechanical Stress Variation	1 pound rms at 1 hertz

Table 6. Test Specifications

Measure	Min	Max
Sense Winding Resistance in ohms	245	285
Insulation Resistance in megohms	1	---
Transportation Spacing in inches	42	44
Mechanical Sensitivity in microvolts per pound	8	18
Magnetic Sensitivity in microvolts per gamma	0.15	0.25

SECTION IV

PRINCIPLES OF OPERATION

This section identifies special circuits used in the tester and the principles involved in the implementation of the mechanical and magnetic response tests. Data acquisition and processing principles are covered in other manuals, as referenced in Section VI.

TEST PRINCIPLES

The test set measures electrical, magnetic, and mechanical characteristics of a MILES transducer. After establishing defined conditions that simulate the environment of an operational MILES transducer, the test set measures the response of the unit under test to the kind of mechanical and magnetic disturbances that might be expected of an armed intruder. These tests are performed on selected sample sections of the unit under test. The center of each test section occurs exactly where the sense winding in the MILES transducer reverses coil direction. This point is called a transposition. The two ends of the test section are approximately 43 inches from the center, which is the nominal distance between transpositions. This configuration ensures that the test conditions are the same for all sections tested.

To perform these tests, the test set must be able to advance the unit under test from the supply reel to the takeup reel, detect each transposition, stop and clamp the unit under test in precisely the right place, impose a sequence of test conditions, and measure the results. To accomplish all this, the test set uses a real-time computer to establish different circuit configurations through a set of programmable relays, control an automatic tester that handles the unit under test, and monitor the results through digital meters.

FUNCTIONAL INTERFACE

Figure 5 illustrates a simplified relationship among the subassemblies of the test set. The subassemblies on the far right and on the far left are in the tester. The UUT is shown in dotted lines, because it is not part of the test set. That portion of the interface circuits that interfaces with the UUT is also in the tester. The remaining subassemblies are part of the console. Through an interface bus, the computer sends commands to those units that are part of the data acquisition system and receives data from multimeter DMM and voltmeter SVM. The numbers shown in parentheses indicate the bus addresses of these units. Digital-to-analog converter DAC, which is also designated a power supply programmer, sends the motor control unit a voltage in the range of 0 to 9.99 volts in response to a digital word from the computer. The motor control unit, in turn, sends a voltage proportional to its input signal to the advance motor or to the rewind motor, as directed by programmed relays in the scanner. The voltage to these motors is approximately 90 volts peak, but its 60-Hz waveform is clipped by SCR circuits in the motor control unit to regulate the power transfer. The voltage, as measured by a digital voltmeter, is approximately 15 volts DC. The scanner also sends a 30-volt signal to the advance or rewind clutch from power supply 1. Other selected relays in the

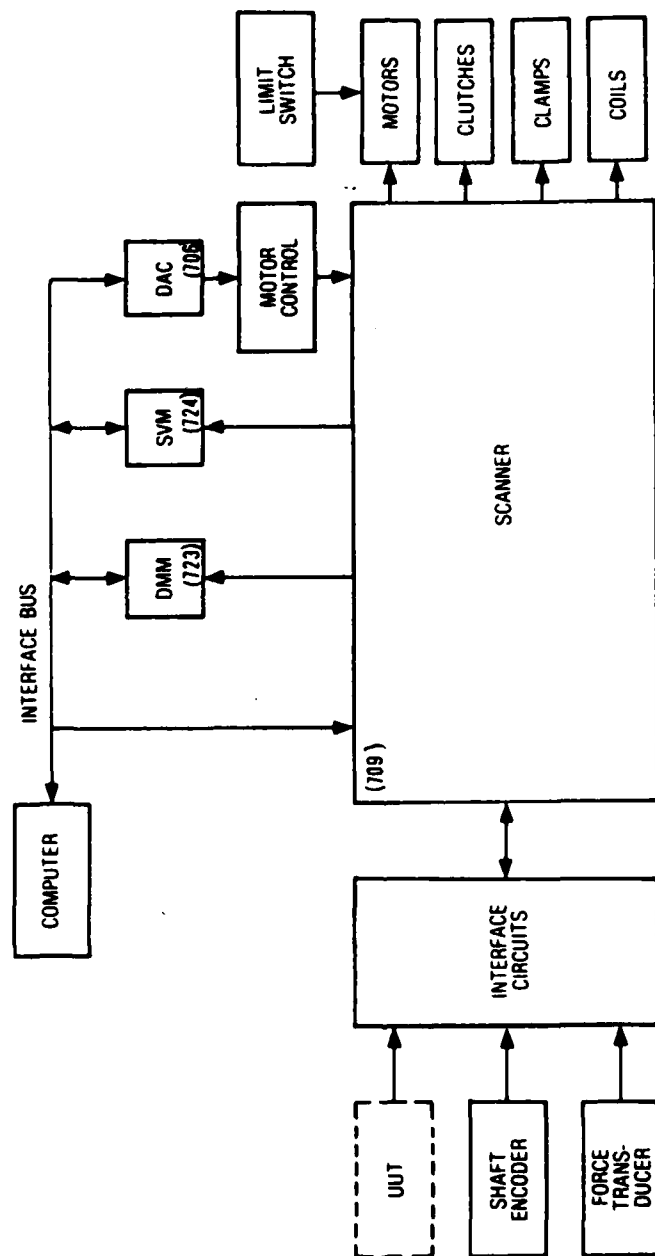


Figure 5. Test Set Functional Interface

scanner send 120 volts AC to solenoids that control pneumatic valves in the clamp assemblies and to the 1-Hz motor through an isolation transformer.

Figure 6 illustrates the relay board layout as seen from the rear of the console. Relay board 1 contains twenty relays, numbered 0 through 19 in order, from top to bottom. Relay boards 2, 3, and 4 contain ten relays each, numbered from top to bottom, where the tens digit indicates the relay board and the units digit, the relay. The low thermal relays of relay board 1 select one channel at a time. The actuator relays in the other boards can select any number of channels at the same time. Relay board 1 selects input channels, and the other relay boards select output channels. Table 7 summarizes the application of the scanner channels. Those not designated are spares.

A limit switch mounted on the supply-rewind assembly disables the advance motor if the unit under test comes off the supply reel. This is a safety feature, which prevents the takeup-advance assembly from running free if the cable comes off the supply reel.

The interface circuits indicated in Figure 5 include a MILES transducer interface assembly, which is mounted on the takeup reel, and a tester interface assembly, which is mounted in the console. The MILES transducer interface circuits transfer signals from the unit under test to the data acquisition system and to the tester interface circuits. The tester interface circuits monitor the shaft encoder and the force transducer in the tester and drive the field coils and the null coil in the tester. Succeeding paragraphs explain these circuit groups.

MILES TRANSDUCER INTERFACE

Figure 7 is a simplified functional representation of the circuits that interface the unit under test. Eight relays establish any of the six circuit configurations. Each decoder input, A_2 , A_1 , or A_0 is a logic 0 or logic 1 as specified by the scanner channels indicated in the logic table. This connects each relay input to 0 or +15 volts. Each of five decoded states energized, the circuit is as shown in the figure. The output of the sense winding, designated sensor, goes through a 60-Hz notch filter and two high-gain amplifiers that are separated by a 2-Hz low pass filter. The first amplifier is designated the preamplifier; the second is, therefore, the post-amplifier. The combined gain is calibrated to 106 db, a voltage gain of 199,526. The filters reduce the noise. A buffer amplifier with unity gain transfers this signal, which is now called Sense, to the output terminal. Sense goes to input channel 4 of the scanner for a voltage measurement and to the correlator for processing.

Calibrate

The test set automatically checks the calibration of the above amplifiers by energizing K3, which connects a resistor across the input, energizing K2, which inputs a 5-volt peak sinusoidal signal from the 1-Hz oscillator in the tester interface circuits, and measuring the voltage output through channel 4.

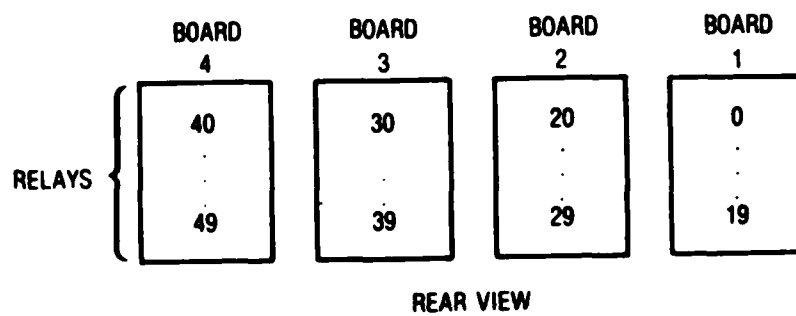


Figure 6. Scanner Relay Boards

Table 7. Control Channels

Input	00 Null
	01 Length
	02 Velocity
	03 Resistance
	04 Correlated Sense
	05 Sense
Output	20 Energize Anchor Clamp
	21 Energize Tension Clamp
	22 Apply Tension
	23 Energize Tension Brake
	24 Energize Stress Clamp
	25 Energize Centering Piston
	26 Apply Power to 1 Hz Motor
	28 Modulate Field Coils With 1-Hz Sinewave Signal
	30 1-set A_0
	31 0-set A_0
	32 1-set A_1
	33 0-set A_1
	34 Saturate Field With 10 Oersteds
	35 Bias Field With 0.25 Oersted
	36 Engage Advance Clutch
	37 Engage Rewind Clutch
	38 Drive Advance Motor
	39 Drive Rewind Motor
	41 Drive Null Coil at 100 Hertz
	42 Supply Magnetic Reference to Correlator
	43 Supply Mechanical Reference to Correlator
	44 0-set A_2
	45 1-set A_2
	46 Send Input to SVM
	47 Send Input to DMM
	49 Disable Length Measurement

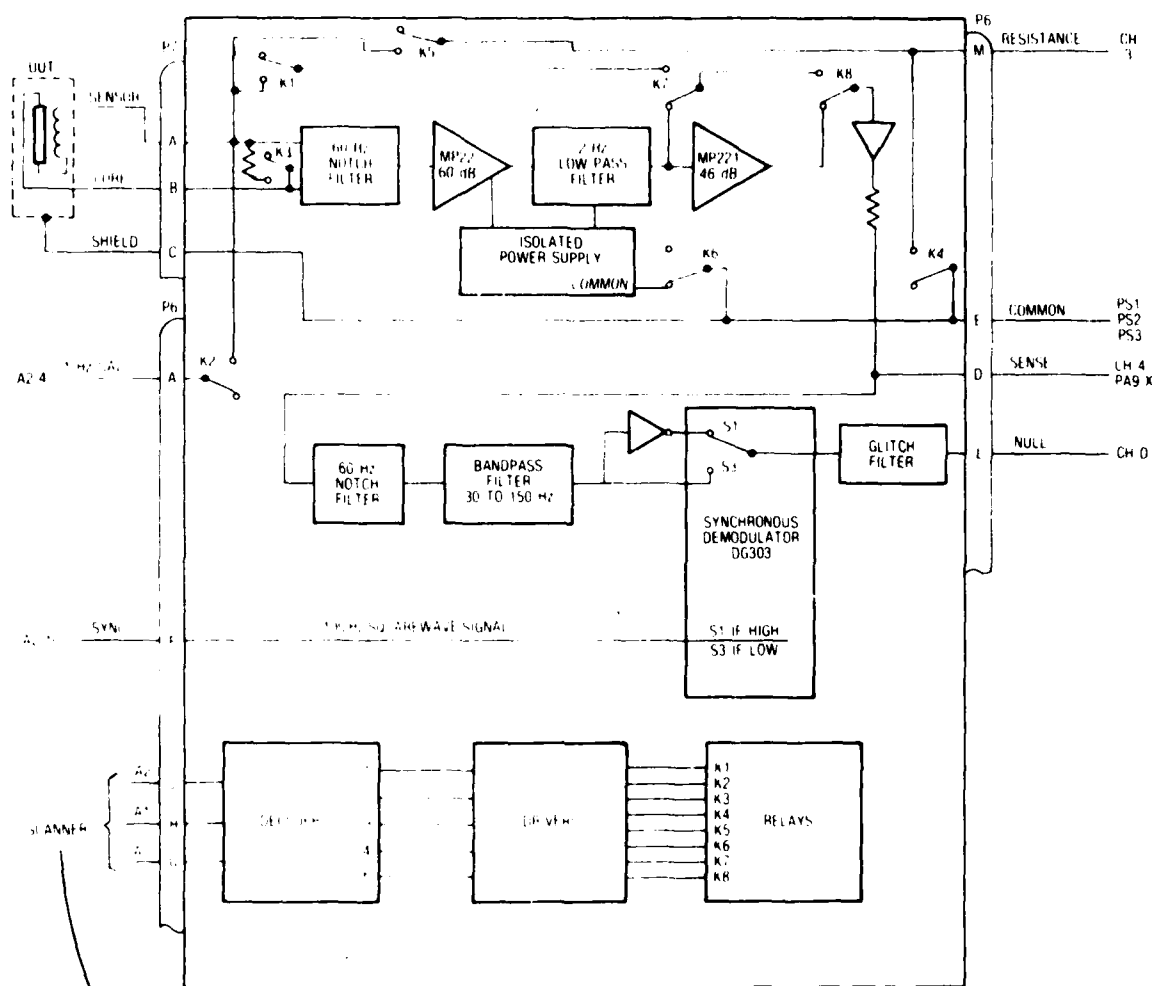


Figure 7. MILES Transducer Interface, Simplified Functional Diagram

ENERGIZE			FUNCTION	
NONE			GAIN	
K1 K7 K8			NULL	
K5			R SENSE WINDING	
K5 K6			R INSULATION	
K2 K3			CALIBRATE	
K4			R SLIP RING	

Resistance

The test set measures resistance with the DMM connected through channel 3 and the common return of power supplies 1, 2, and 3. Energizing K4 shorts these two terminals, allowing the DMM to read the resistance of the slip rings. Energizing K5 connects the sense winding to the DMM with the other end returning through the core and the common side of the amplifier circuit. Energizing K5 and K6 connects the DMM from the sense winding to the shield to measure insulation resistance. K6 opens the return path from the sense winding, allowing the common of the isolated power supply to rise above the common line connected to the shield.

Null

The test set detects sense winding transpositions by inducing a 100-Hz signal into the sense windings through a null coil and measuring the effect of the phase shift as the transposition goes through the null coil. The output of the sense winding bypasses the preamplifier and postamplifier through relays K1, K7, and K8. The buffer amplifier sends the signal to a bandpass filter which restricts the signal to a band between 30 and 150 Hz. That signal and its inverse then go to a synchronous demodulator, where an FET switch controlled by a 100-Hz squarewave signal alternately selects the output of the filter and its inverse. A short time-constant filter removes the glitches from the selected signal, which then goes to channel 0 as Null. Figure 8 illustrates the results of this signal processing. The null coil excitation is a triangular waveform that peaks at the same time that the sync signal switches the demodulator. As a transposition approaches the null coil, the induced voltage decreases in amplitude, and there is a phase reversal as the transposition goes through the null coil. The demodulated signal, therefore, reverses polarity at that point. A 5-microsecond negative pulse, which is formed from the transition of the sync signal, triggers the SVM to read the voltage at each peak of the resulting null signal for maximum signal-to-noise discrimination. The change in polarity signifies the transposition. The illustrated waveforms are idealized for clarity. Also, the filters introduce a slight delay in the detected signal; the program compensates for this by introducing a corresponding delay in the voltmeter reading.

TESTER INTERFACE

Figure 9 illustrates the simplified functional interface between the console and the tester. Scanner relays control the circuit configuration. Written above each relay is the channel number by which the computer selects that relay. Each channel has two relays, and the letter A or B preceding the contact number distinguishes the relay. Often, however, only one of the relays in a given channel is used.

Length Measurement

An advancing MILES cable turns the wheel of a shaft encoder assembly, which generates a hundred 5-volt pulses per inch of advance. This output signal, Motion, is the input to the length measurement circuit. Unless inhibited by channel 49 (disable = 0), a gate transfers the input signal to a frequency-to-voltage converter and to a divide-by-five counter. The output of the converter

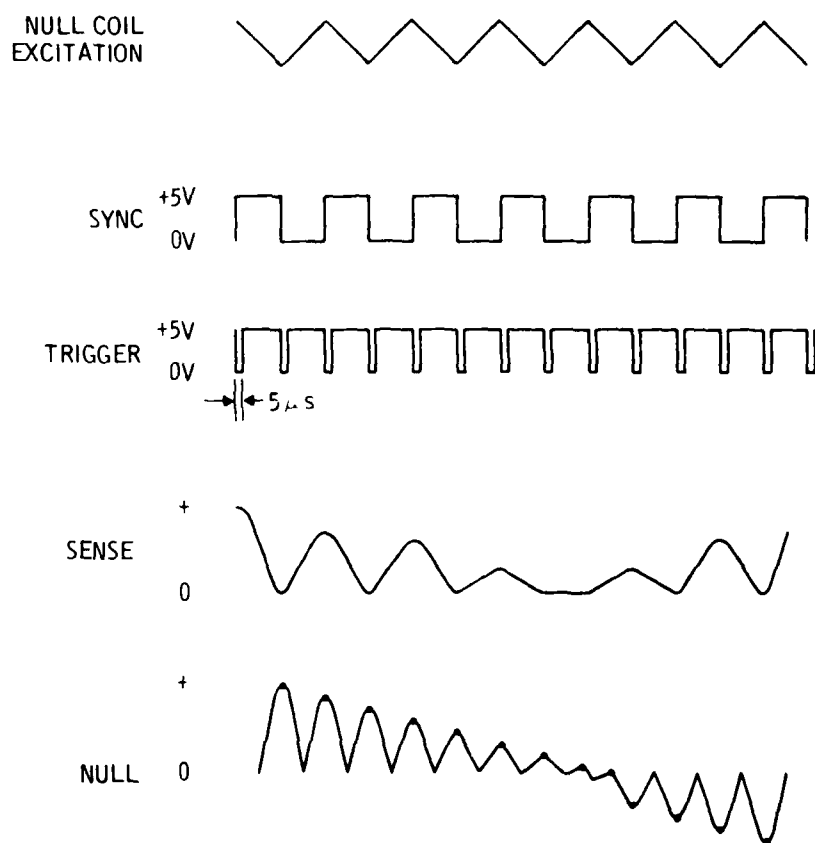
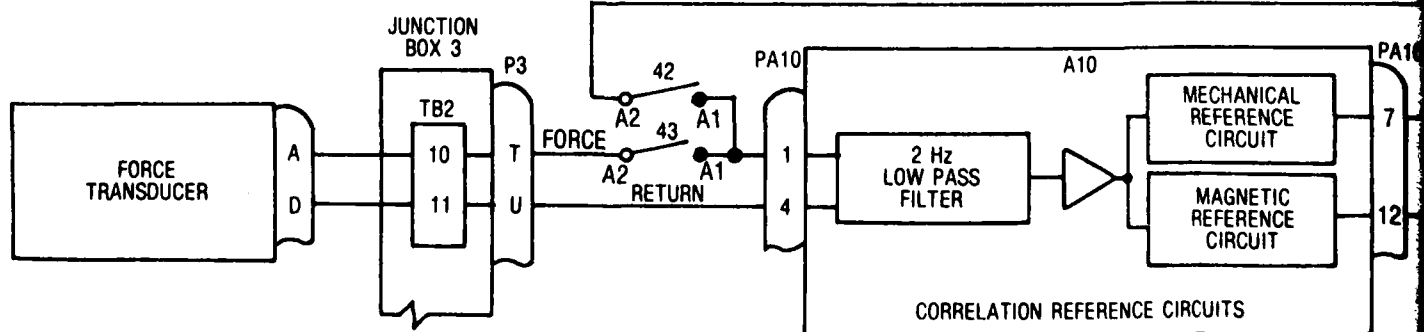
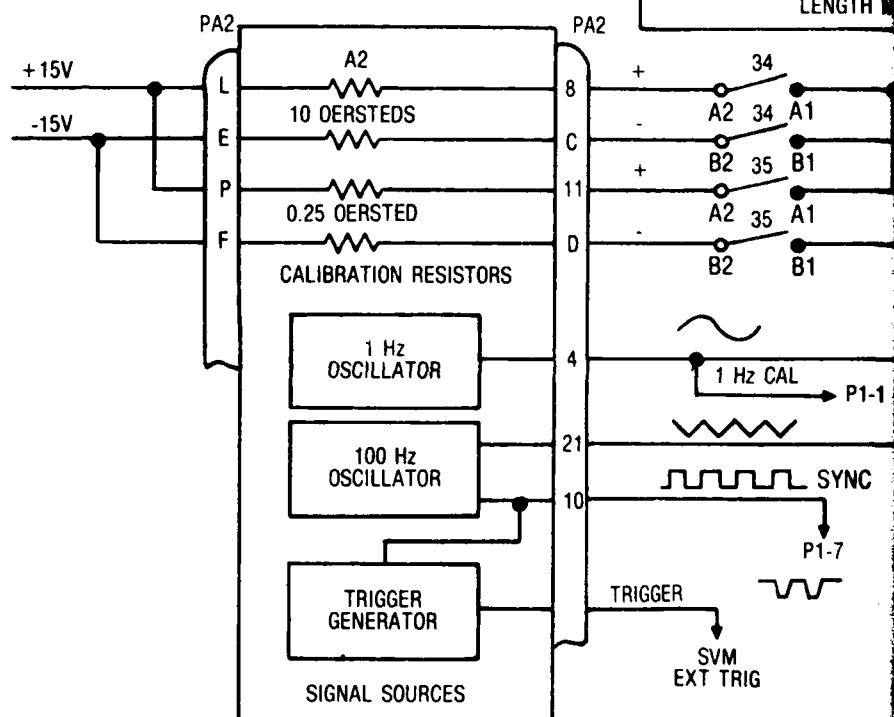
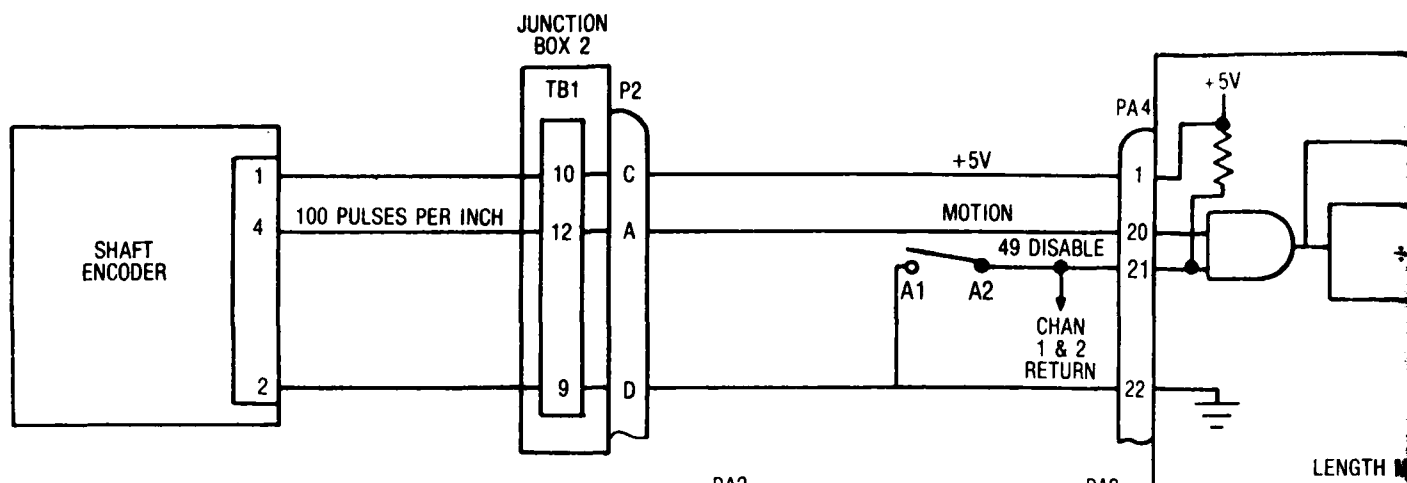


Figure 8. Null Detection Waveforms



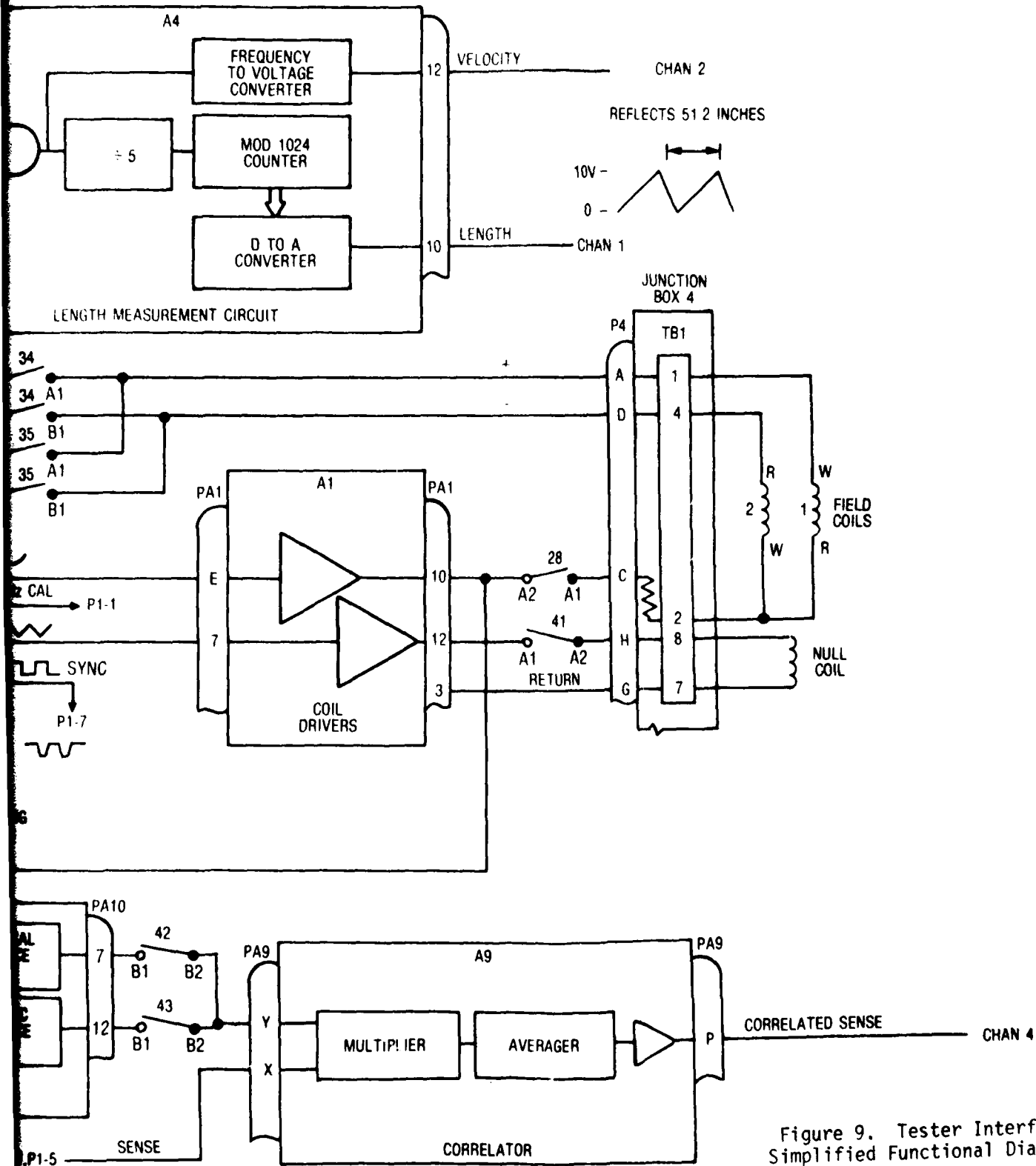


Figure 9. Tester Interface,
Simplified Functional Diagram

is a voltage that represents the velocity of the unit under test. The output of the divider increments a modulo 1024 counter. A digital-to-analog converter converts the count in the modulo 1024 counter to a voltage that represents the length of the unit under test in increments of 51.2 inches. The program accumulates the multiples, as the length indication rises 1 volt for each 5.12 inch increment of forward motion. The SVM reads length or velocity through channel 1 or 2, as directed by the program, and the program disables the input through channel 49 to prevent noise when the MILES cable is stopped.

Magnetic Signal Generation

The magnetization routine saturates the field coils by connecting the coils in series through channel 34 to a 30-volt source and a set of calibration resistors that limit the magnetization to 10 oersteds. The routine then switches in another set of calibration resistors through channel 35 and opens channel 34 to reduce the magnetization to 0.25 oersted. This routine establishes a defined field bias for the sensitivity tests.

Figure 10 is a simplified illustration of the magnetization process. The calibration resistors and the field coil circuit are shown in Figure 9. A 1-Hz oscillator generates the 5-volt peak sinusoidal signal that is the calibration input to the sense amplifiers. This same 1-Hz signal modulates the field coils during the magnetic sensitivity test. A coil driver applies the modulation signal through scanner channel 28 and a calibration resistor to the center of the two field coils. The return path is through the power supply. The calibration resistor ensures that the 1-Hz signal varies the magnetic field 100 gamma peak about the 0.25 oersted bias.

A 100-Hz oscillator generates the triangular excitation signal and the square-wave sync signal described above. A coil driver applies the excitation signal through scanner channel 41 to the null coil.

Correlation

To measure the sensitivity of the MILES transducer to controlled mechanical and magnetic disturbances, the test set reduces spurious responses by band limiting in the low level circuits, cross-correlating the resulting sense signal with a synchronous mechanical or magnetic reference, and averaging the result over a period of several seconds.

Correlation reference circuits establish a magnetic reference through scanner channel 42 or a mechanical reference through scanner channel 43. The magnetic reference signal source is the output of the 1-Hz driver. The mechanical reference signal source is the force transducer, which produces a 1-Hz signal as a result of the stress imposed by the 1-Hz modulation motor. The selected 1-Hz signal goes through a 2-Hz low pass filter and a buffer amplifier to a magnetic reference circuit and to a mechanical reference circuit.

The amplitude and phase of the output of each of these correlation reference circuits are adjusted to match those of the sense signal. The scanner channel that selects the input to the reference circuit also selects the output. The correlator multiplies the selected reference signal and the sense signal, scales the product, and averages the product over a period of several seconds

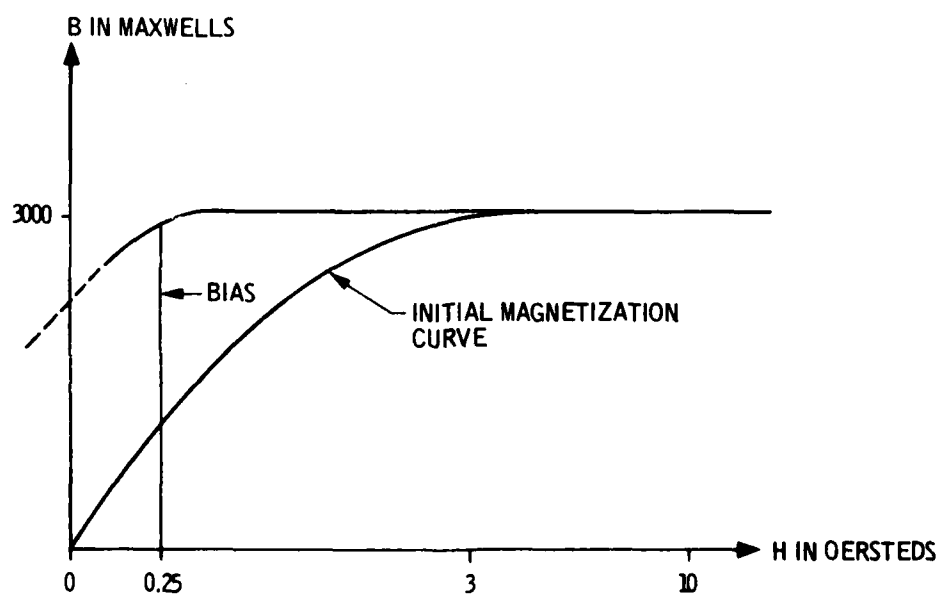


Figure 10. Field Magnetization Curve

to produce the correlated sense signal. This output equals the product of the peak amplitude of each input divided by 20 and multiplied by the cosine of the phase angle between them.

Figure 11 illustrates the characteristics of the interface signals.

INPUT DATA SELECTION

Figure 12 is a simplified representation of the data acquisition input circuit. The numbers in parentheses are those used by the program to address the particular device on the computer interface bus. To read resistance, for example, the computer signals unit 709 to set up a relay configuration that places the resistance to be measured between the channel 3 input and the common return and to close channels 3 and 47. The computer then sends a trigger signal and a read command to 723 and stores the result.

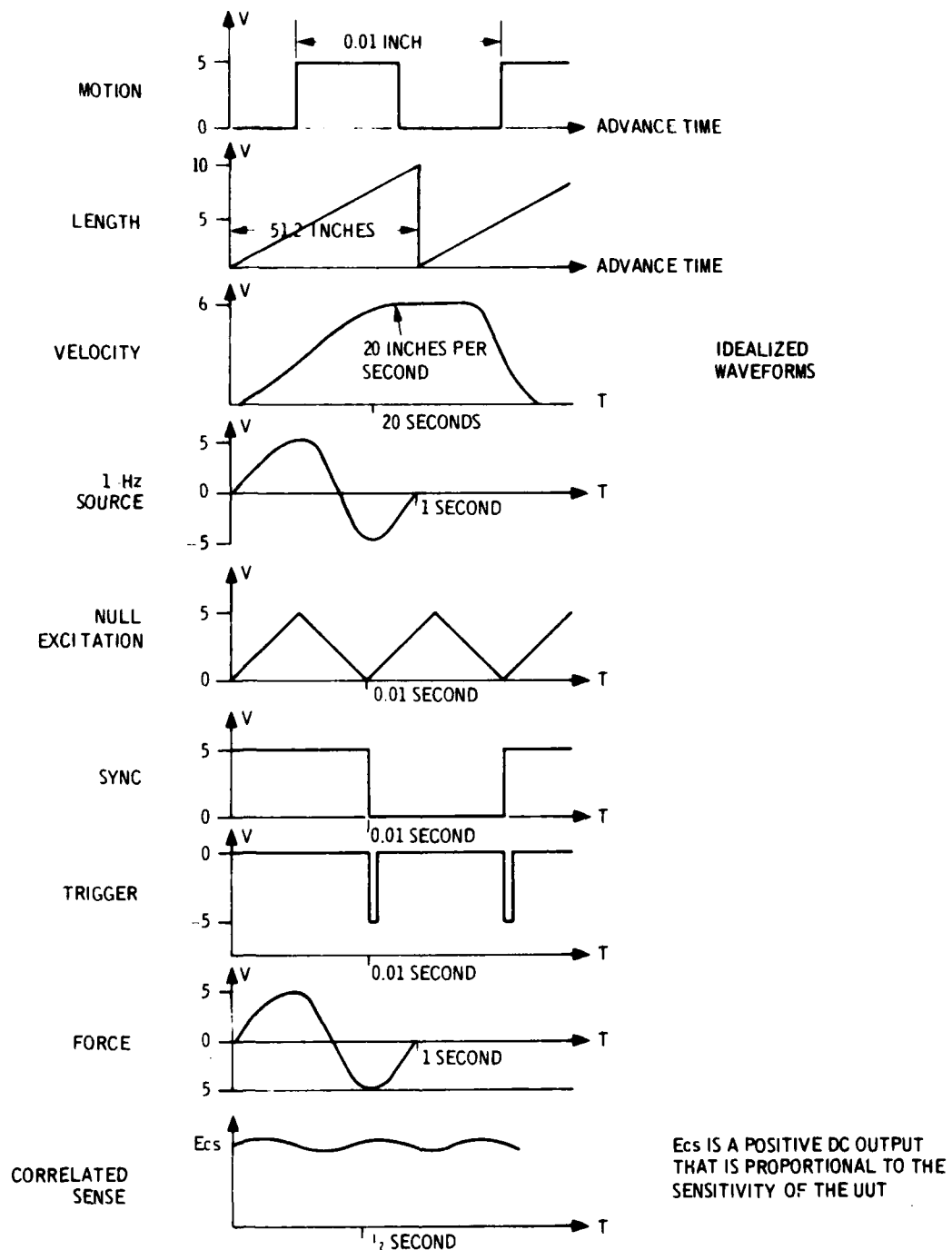


Figure 11. Interface Signals

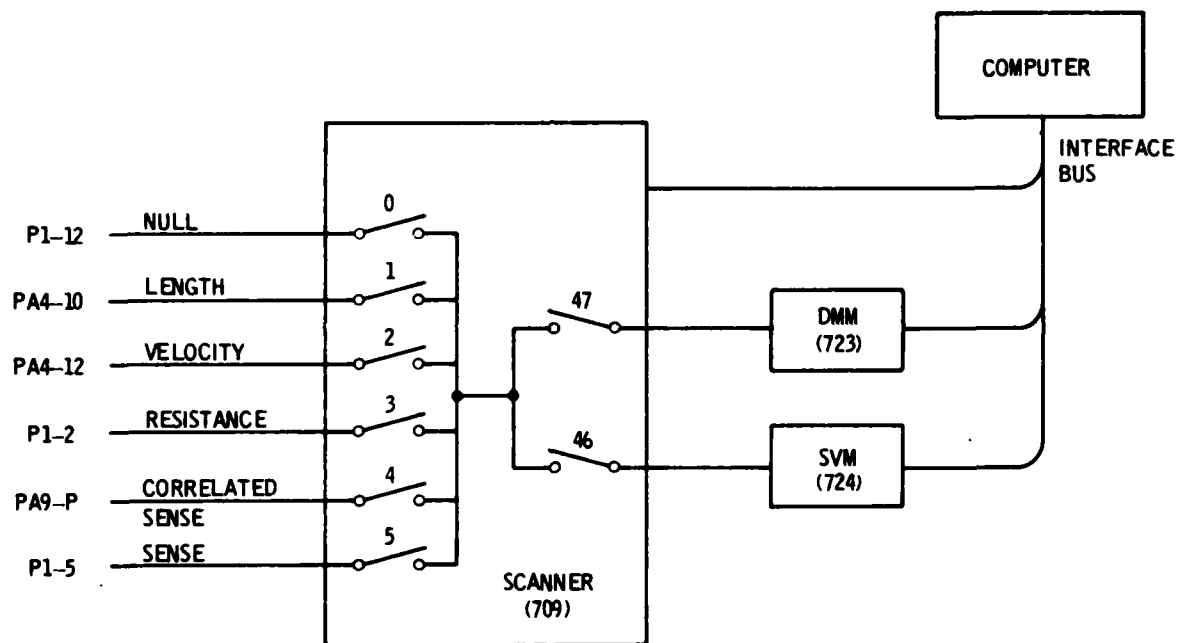


Figure 12. Input Data Selection

SECTION V

TEST SET VERIFICATION

PURPOSE

Both of the TS-3753/U Transducer Test Sets were tested at the contractor site. These tests were designed to demonstrate or verify that the systems would indeed perform the functions set forth in the statement of work.

VERIFICATION TESTING

Verification was performed in accordance with Acceptance Test Procedures. Since these procedures were not formally submitted under this contract, they have been included as attachments to this document. Also contained in the attachments are the actual data sheets and computer printouts. Attachment 1 is for test set serial number 1 and Attachment 2 is for serial number 2.

The tests are listed in section 4 of the ATP. The data sheets and printouts are referenced by paragraph numbers to the pertinent ATP test.

Also contained in the last printout are the results of the test witnessed by the Government representative.

RESULTS

The results of verification testing indicate that the test set performed in accordance with design requirements.

CONCLUSIONS

The TS-3753/U Transducer Test Set provides an effective means for testing the MILES transducer. The unit fulfills design requirements in that it:

1. Provides repeatable results in the measurement of the MILES transducer parameters.
2. Provides a high degree of confidence in the condition of the tested transducer.

SECTION VI

REFERENCES

1. MILES Pressure/Seismic Response (Evaluation of Advanced Development Model of MILES Test Fixture) dated June 1979.
2. Transducer, Motional Pickup TR-299/G(), Military Specification MIL-T-38531(17) dated 15 March 1976.
3. Phase I Report for MILES Pressure/Seismic Response dated 19 February 1977.

APPENDIX A

AUTO TEST FLOW CHART

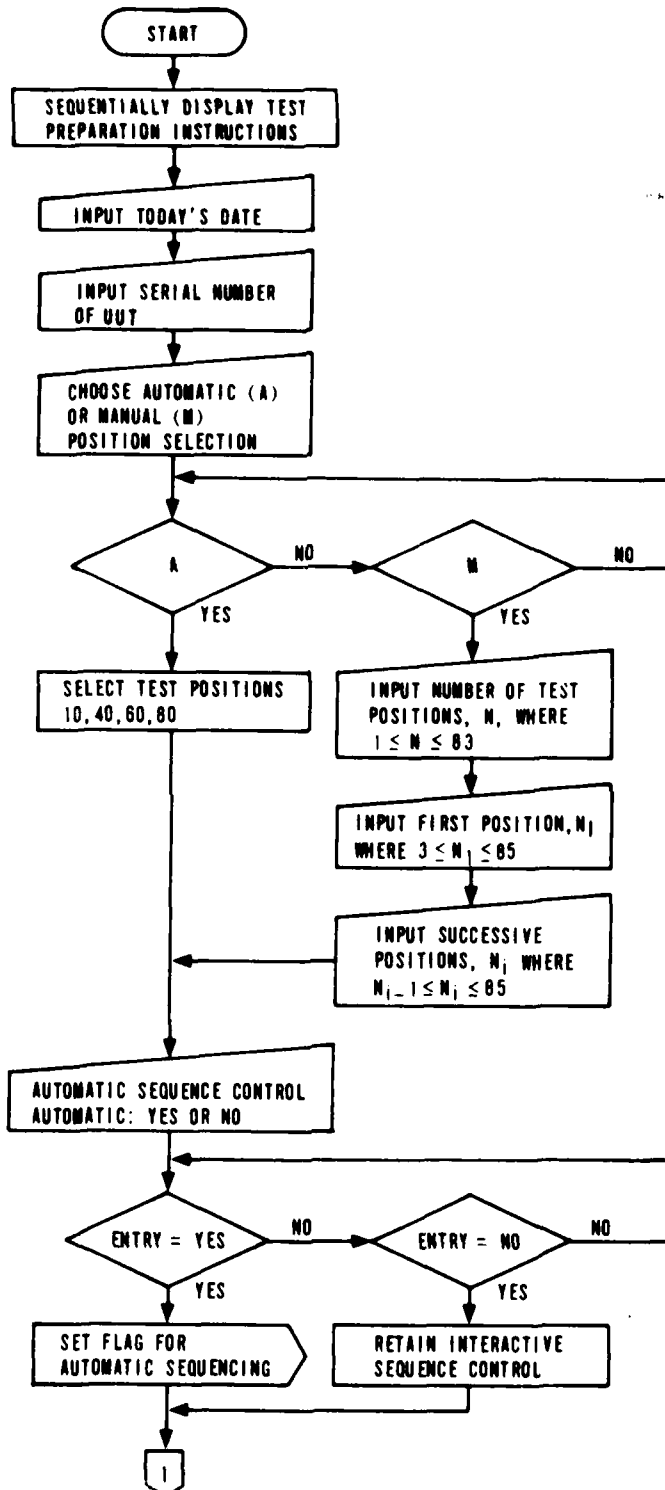


Figure A-1. Auto Test Program
Flow Chart (Sheet 1 of 6)

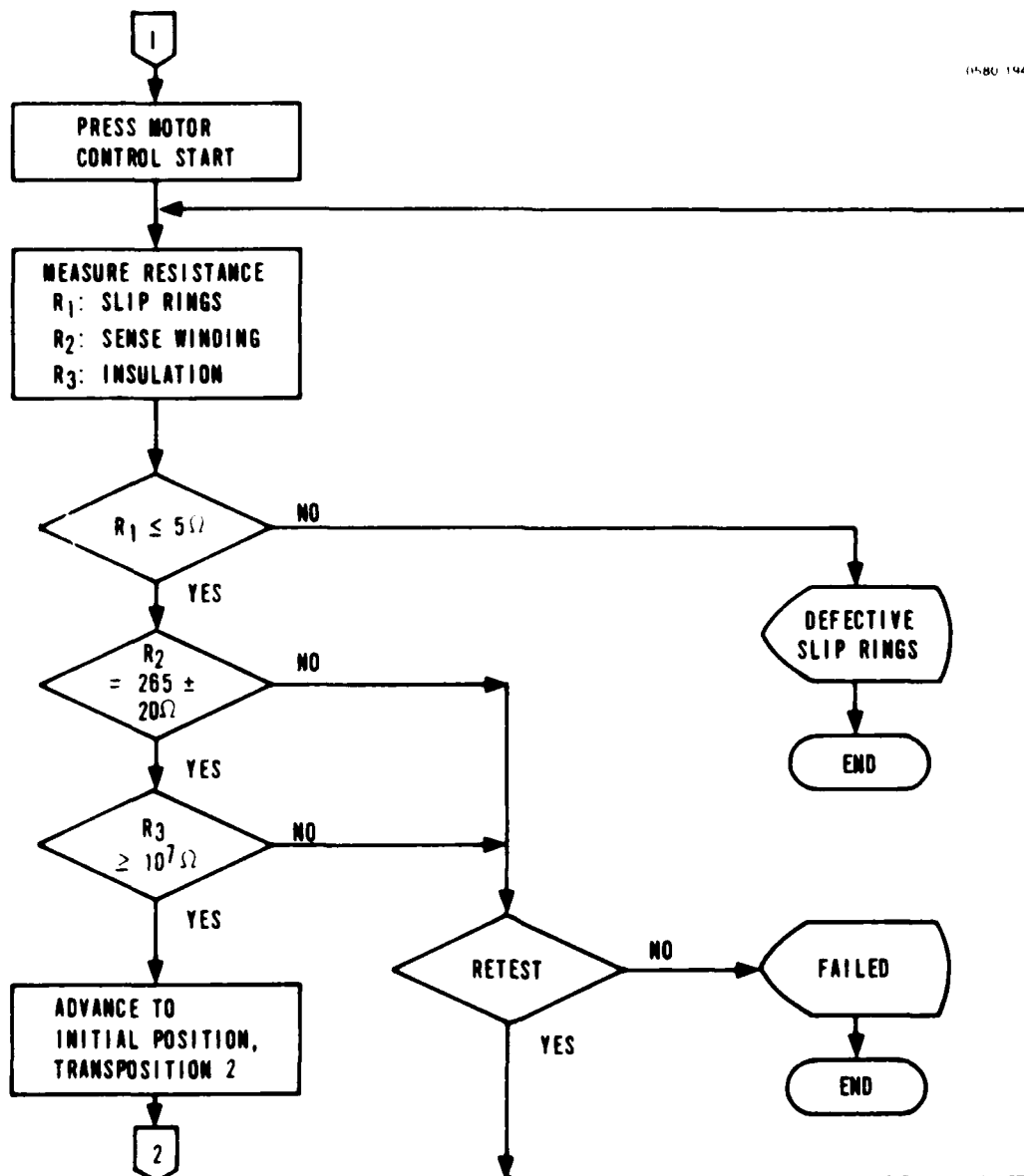


Figure A-1. Auto Test Program
Flow Chart (Sheet 2 of 6)

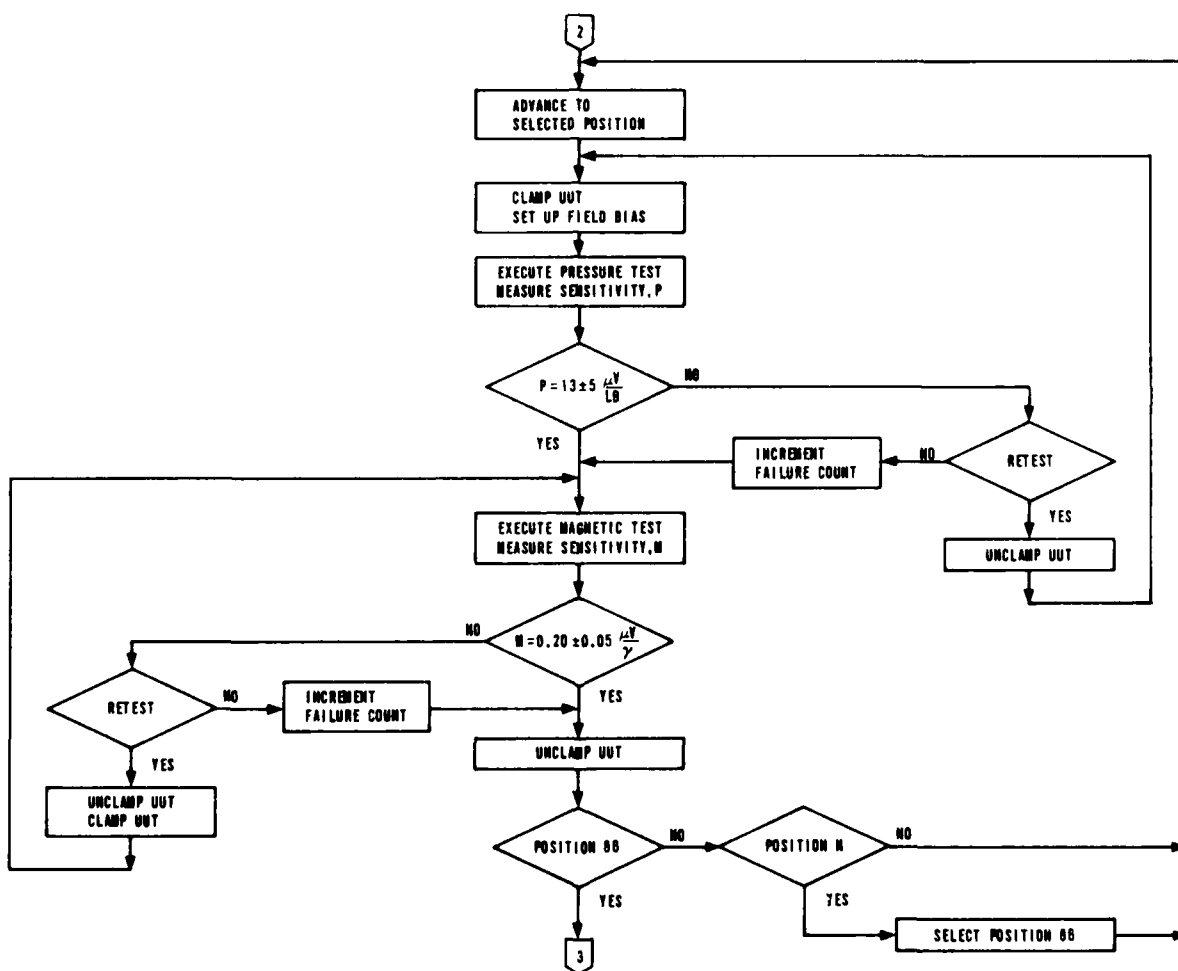
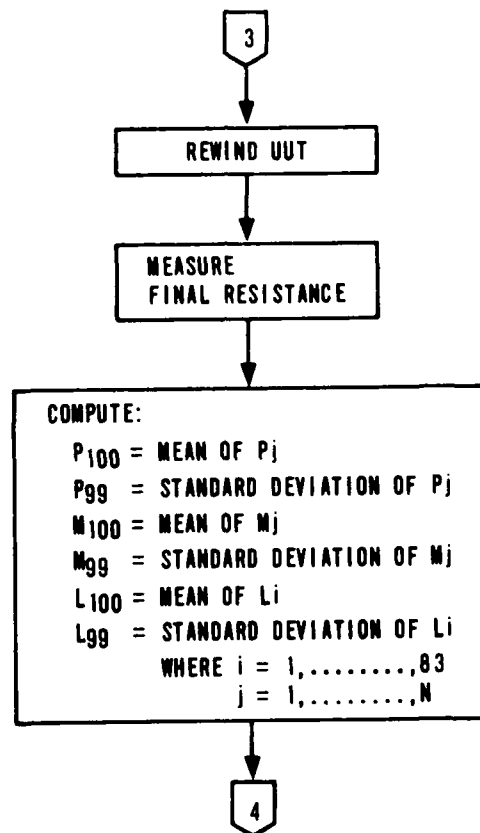


Figure A-1. Auto Test Program
Flow Chart (Sheet 3 of 6)



NOTE

The subscripted parameters P_j and M_j refer to the pressure sensitivity and magnetic sensitivity, respectively, of the two transducer winding segments coincident on the i th transposition test point selected. The subscripted parameter L_j refers to the distance between transposition $i+2$ and $i+1$ where transposition 1 is located between the first and second transducer winding segments.

Figure A-1. Auto Test Program
Flow Chart (Sheet 4 of 6)

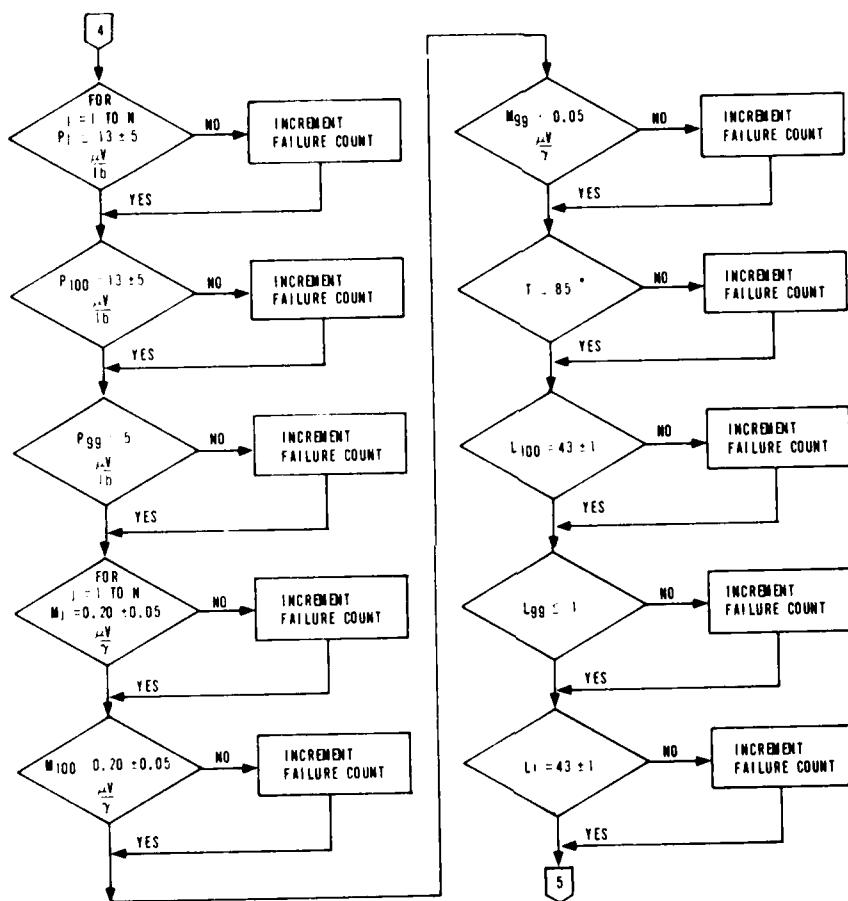


Figure A-1. Auto Test Program
Flow Chart (Sheet 5 of 6)

Q CABLE LENGTH FROM
TRANSPPOSITION 2
TO TRANSPPOSITION 87

R₂₀ ORIGINAL SENSE
WINDING RESISTANCE

R₂ FINAL SENSE
WINDING RESISTANCE

R₃₀ ORIGINAL INSULATION
RESISTANCE

R₃ FINAL INSULATION
RESISTANCE

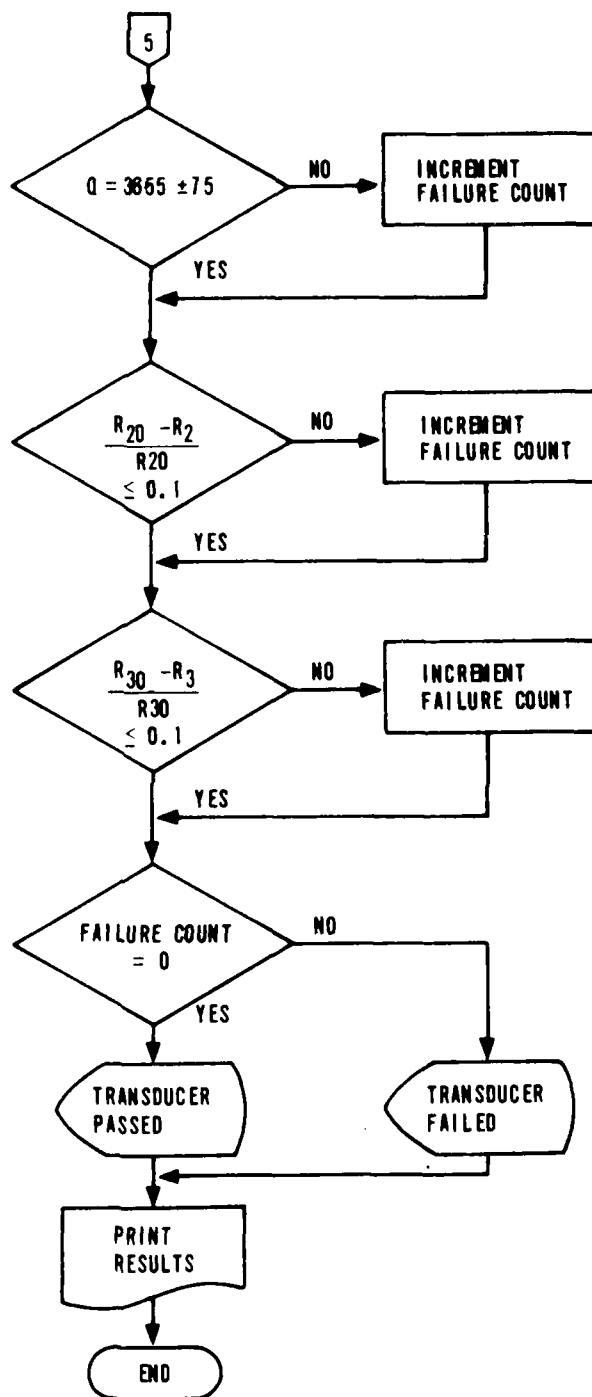


Figure A-1. Auto Test Program
Flow Chart (Sheet 6 of 6)

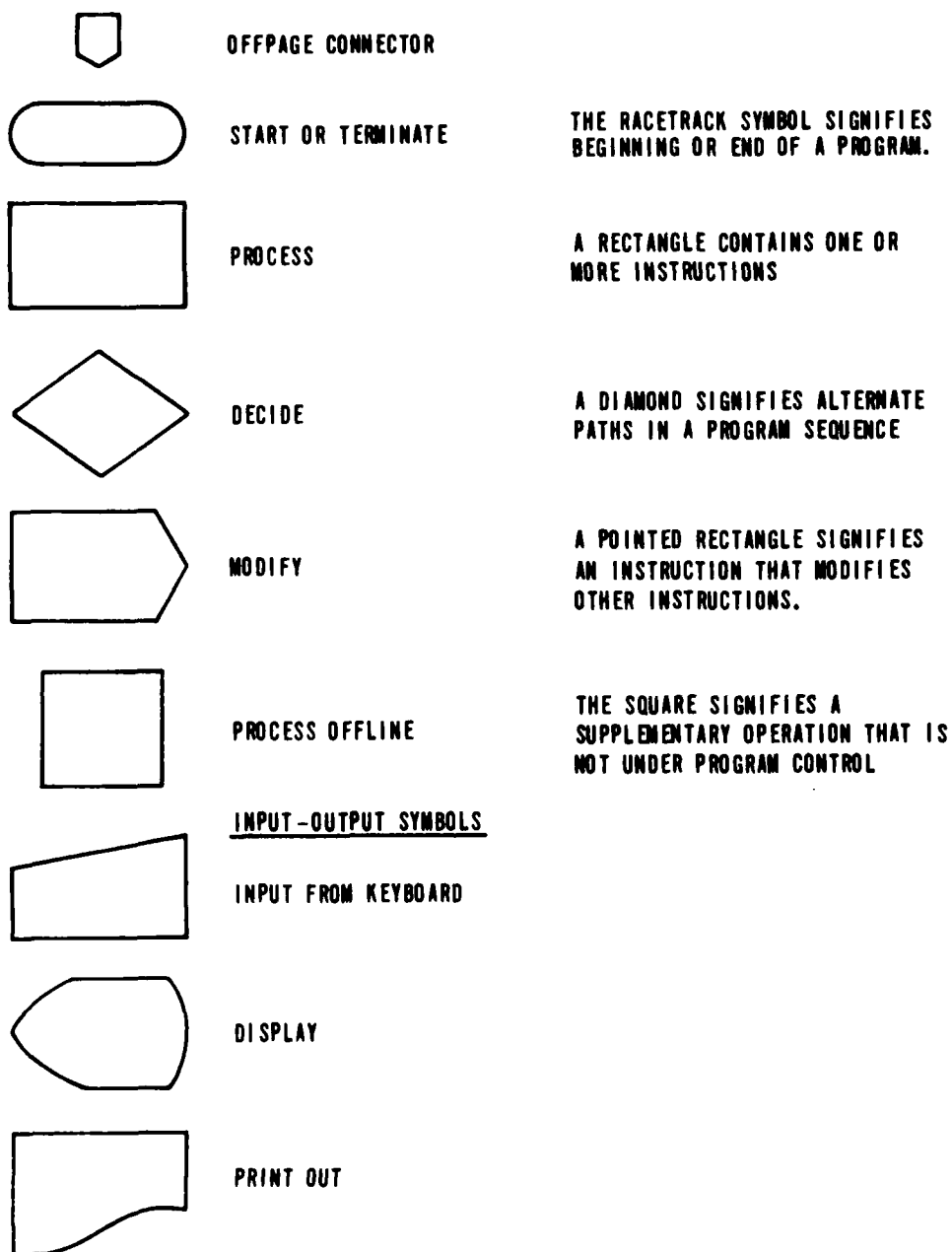


Figure A-2. Definition of Symbols

APPENDIX B

AUTO TEST PROGRAM LISTING

```

0: dim A$(16),
  B$(16),C$(16),
  D$(20),G$(16),
  P(100),M(100),
  L(0:100),T(10)
1: dim N(100):
  0=B:0=L(0):1=T
2: spc 2:prt "++
  ++++++"
3: prt "MILES
  TRANSDUCER AUTO
  MATIC TEST"
4: prt "+++++
  ++++++"
5: spc 2:beep:
  dsp "LOAD
  SUPPLY REEL"
  stp
6: beep:dsp "
  ALIGN LEVEL
  WINDER" :stp
7: beep:dsp "
  THREAD MILES
  TRANSDUCER"
  stp
8: wrt 709,"C"
9: beep:prt "
  INPUT TODAY'S
  DATE ",A$:if
  A$="" :jmp 0
10: spc :wrt 16,
  " ",A$
11: beep:prt "
  INPUT MILES
  TRANSDUCER SERI
  AL #",B$:if
  B$="" :jmp 0
12: spc :wrt 16,
  "SERIAL #",B$:
  spc 2
13: ent "INPUT
  PTS SELECTION
  AUTO-MAN:A:M",
  C$
14: if C$="A":
  if C$="a":if
  C$="n":if C$="n"
  :jmp -1
15: if C$="A":
  asb "AUTO"
16: if C$="a":
  asb "AUTO"

```

```

17: if C$="M":
  asb "MANUAL"
18: if C$="m":
  asb "MANUAL"
19: ent "INPUT
  AUTOMATIC SEQUE
  NCING: Y/N",G$:
  if G$="" :jmp 0
20: if G$="Y":
  if G$="Y":if
  G$="N":if G$="n"
  :jmp -1
21: if G$="":
  dsp "AUTOMATIC
  OPERATION SELEC
  TED":beep:"YES"
  +G$:stp
22: if G$="Y":
  dsp "AUTOMATIC
  OPERATION SELEC
  TED":beep:"YES"
  +G$:stp
23: dsp "PRESS
  MOTOR CONTROL
  START BUTTON"
  stp
24: prt ":::::
  :::::"
25: asb "measure
  res"
26: beep:r2+r20:
  r3+r30
27: dsp "INITIAL
  POS.,PRESS CONT
  INUE":beep:if
  G$="YES":stp
28: asb "find
  transposition
  2"
29: dsp "N POSIT
  IONING PRESS
  CONT":beep:
  if G$="YES":
  stp
30: for I=1 to N
31: dsp "POSITIO
  N # ",I," IN
  PROCESS"
32: asb "NOII
  positionine"
33: next I

```

```

34: dsp "FINAL
  POSITIONING ":
  beep:if G$="YES"
  :stp
35: spc : "final"
  +B$
36: asb "final
  positionine"
37: beep
38: dsp "READY
  FOR REWIND":if
  G$="YES":beep:
  stp
39: asb "rewind"
40: dsp "READY
  FOR DATA REDUCT
  ION":beep:if
  G$="YES":stp
41: asb "measure
  res"
42: asb "data
  reduction"
43: "END":
44: wrt 709,"C"
45: spc 4
46: dsp "%%%%%%
  %% END OF TEST
  %%%%%%%%%"
  beep
47: end
48: "measure
  res":
49: dsp "RES.
  MEASUREMENT
  ROUTINE,CONT":
  beep:if G$="YES"
  :stp
50: dsp "RES.
  MEASUREMENT IN
  PROCESS"
51: for X=1 to 3
52: if X=1:wrt
  709,"C","313245
  4703"
53: if X=2:wrt
  709,"C","313244
  4703"
54: if X=3:wrt
  709,"C","303244
  4703"
55: clr 723:wait
  500

```

```

56: tra 723:red
723:0.
57: clr 723:wait
500
58: tra 723:red
723:0$
59: val(0$)*10to
all(0$(81))+0
60: if X=1:0+r1
61: if X=2:0+r2
62: if X=3:0+r3
63: next X
64: "SLIPRING
MEASUREMENT":
65: r1+S
66: if S>5:eto
"BAD SLIPRING"
67: eto "DCR"
68: "BAD SLIPRING"
69: prt " DEFE
CTIVE "prt "
SLIPRING"
70: prt " TEST
ABORTED"
71: dsp "XXXXXX
DEFECTIVE SLIPR
INGS XXXXXX"
72: for 0=0 to
200
73: beep:wait 50
74: next 0
75: end
76: "DCR":
77: dsp " CABLE
RES. MEASURE
IN PROCESS"
78: if abs(r2-
265)>20:eto
"BADDCR"
79: fmt 6,"DCR
=",f3.0," ",b
80: wrt 16.6,r2,
17
81: "IR MEASUREM
ENT":
82: if r3>1e7:
eto "BADIR"
83: if r3>1.9e7:
190000000+r3
84: fmt 6,"IR =
",f9.0," ",b

```

```

85: wrt 16.6,r3,
17
86: ret
87: "BADIR":
88: for Y=1 to
200:beep:wait
50:next Y
89: ent "RETEST
CABLE DCR&IR "
INPUT Y/N",A$
90: if A$#"Y":
if A$#"Y":E+
1+E:eto "TESTFA
IL"
91: prt "RES.
RETEST"
92: eto "measure
res"
93: ret
94: "BADDCR":
95: for Y=1 to
200:beep:wait
50:next Y
96: ent "RETEST
CABLE DCR&IR "
INPUT Y/N",A$
97: if A$#"Y":
if A$#"Y":E+
1+E:eto "TESTFA
IL"
98: prt "RES.
RETEST"
99: eto "measure
res"
100: ret
101: "TESTFAIL":
102: spc 2
103: prt "TEST
FAILURE "":spc
104: fmt f3.0
105: wrt 16,"#
OF FAILURES":E:
spc
106: dsp " C
TRANSDUCER TEST
FAILED "":
107: beep
108: end
109: "BADDCR":
110: ent "RETEST
DCR INPUT Y/
N",A$

```

```

111: if A$#"Y":
if A$#"Y":E+
1+E:eto "TESTFA
IL"
112: spc prt
"DCR RETEST"
113: eto "dcrtes
t"
114: ret
115: "BADIR":
116: ent "RETEST
IR INPUT Y/N",
A$
117: if A$#"Y":
if A$#"Y":E+
1+E:eto "TESTFA
IL"
118: spc prt
"IR RETEST"
119: eto "irtest
"
120: ret
121: "find trans
position 2":
122: dsp "SEEKIN
G INITIAL POSITI
ON"
123: wrt 706,
"2000"
124: "close adv
clutch":
125: "set preamp
to null mode":
126: "turn on
null coil":
127: "lin/sec
to adv motor":
128: "turn motor
on":
129: fmt 4,c,z
130: wrt 709,
"C", "3033363841
444600"
131: "set up
3MM":wrt 724,
"0.0015S,N1S,
T2,R1"
132: wait 1000
133: wrt 706.4,
"2100"
134: "calculate
null":
135: red 724,v

```

```

136: if V<.06:
  jmp -1
137: red 724,r4
138: red 724,r5
139: red 724,r6
140: (r4+r5+r6)/
  3+r4
141: red 724,V
142: if V-r4>0:
  jmp -1
143: "found null
  ,read length":
144: wrt 709,
  "C","4601"
145: asb "length
  measurement"
146: L+W
147: ret
148: "final posi
  tioning":
149: 86+N[I];N+
  1+I
150: prt "FINAL
  POSITION"
151: asb "N[I]
  positioning"
152: ret
153: "rewind":
154: "clear":wrt
  709,"C"
155: 1+Ki:wrt
  500
156: wrt 724,
  "R3T1"
157: "measure
  final length":
158: "setup rew
  ind motor":wrt
  709,"3.3739"
159: "setup rew
  ind motor":
160: asb "length
  measurement"
161: L-W+0
162: fct 2+.4.0,
  Z
163: 3180+A
164: "turn on
  rewind motor":w
  rt 709,"3.39373
  033:4.4446

```

```

165: "measure
  L":asb "length
  measurement"
166: dsp "CABLE
  LENGTH = ",2+0-
  L+W," IN."
167: if L-W+300>
  2+0:-3+K
168: if L>2+0-
  25:wrt 709,"C":
  ret
169: if A<2998:
  2998+A
170: if A<2200:
  2200+A
171: A+A+A
172: wrt 706.2,A
173: ato "measur
  e L"
174: ret
175: "MANUAL":
176: dsp "MANUAL
  TEST POINTS
  SELECTION":beep
  :sto
177: dsp "TWO
  TEST POINTS
  MINIMUM":beep:
  sto
178: ent "INPUT
  # OF DESIRED
  TEST POINTS":N:
  beep;if N<1:
  jmp 0
179: if N<84:
  dsp "TEST POIN
  T MUST BE <
  84":beep:sto :
  jmp -1
180: if N=1:ato
  "one test pt"
181: for I=1 to
  N
182: beep
183: if I#1:jmp
  2
184: ent "INPUT
  FIRST TEST POIN
  T LOCATION",
  N[I]
185: if I#N:jmp
  2

```

```

186: ent "INPUT
  LAST TEST POINT
  LOCATION":N[I]
187: if I=1:jmp
  5
188: if I=N:jmp
  2
189: ent "INPUT
  NEXT TEST POINT
  LOCATION":N[I]
190: if N[I]>N[I
  -1]:jmp 2
191: beep:dsp
  "TEST PT MUST
  EXCEED PREVIOUS
  PT":sto :jmp -
  6
192: if N[I]<=2:
  dsp "FIRST TEST
  POINT MUST BE
  > 2":beep:sto :
  jmp -10
193: if N[I]>=86
  :dsp "TEST
  POINT LOCATION
  <86":beep:sto :
  jmp -11
194: next I
195: ret
196: "one test
  pt":
197: ent "INPUT
  TEST POINT LOCA
  TION":N[I]
198: if N[I]<=2:
  dsp "TEST POINT
  MUST BE > 2":
  beep:sto :jmp -
  2
199: if N[I]>=85
  :dsp "TEST POIN
  T MUST BE < 86":
  beep:sto :jmp -
  2
200: ret
201: "AUTO":
202: dsp "AUTOMA
  TIC MODE SELECT
  ED":beep:sto
203: dsp "PTS:
  10-40-60-80
  WILL BE TESTED"
  :beep:sto

```

```

204: 10+N[1];
    40+N[2];60+N[3]
    180+N[4]
205: 4+N
206: ret
207: "transposit
    ion test":
208: wrt 709,"C"
209: wrt 709,
    "46"
210: wrt 706,
    "2000"
211: dsp "N POSI
    TIONING ":beep
    if G##"YES":
    stp
212: for I=1 to
    N
213: asb "N[I]
    positioning"
214: beep
215: next I
216: dsp "FINAL
    POSITIONING ":
    beep;if G##"YES"
    :stp
217: "clamping
    sequence":dsp
    "CLAMPING PROCE
    DURE IN PROCESS"
218: wrt 709,
    "C","494602"
219: "is velocit
    y=0":wait 50
220: tr 724
221: red 724,V
222: if V>.05:
    jmp -1
223: wait 1000
224: "zero mech"
    :wait 750:wrt
    709,"25":wrt
    709,"4,49"
225: "close stat
    ionary":wait
    750:wrt 709,
    "20"
226: "close tens
    ion clamp":wait
    750:wrt 709,
    "21"
227: "appl. tens
    ion":wait 750:
    wrt 709,"22"
228: "close tens
    ion brake":wait
    750:wrt 709,
    "23"
229: "relax tens
    ion":wait 750:
    wrt 709,"2,2021
    2325"
230: "close cent
    er clamp":wait
    750:wrt 709,
    "24"
231: "relax zero
    mech":wait
    750:wrt 709,"2,
    20212324"
232: ret
233: "unclamping
    sequence":dsp
    "UNCLAMPING
    PROCEDURE IN
    PROCESS"
234: wait 1000
235: "open cente
    r clamp":wrt
    709,"2,202123"
236: "apply zero
    mech":wait
    1000:wrt 709,
    "2,20212325"
237: "open tensi
    on brake & clam
    p":wait 1000:
    wrt 709,"2,2025"
238: "open stati
    onary clamp":wa
    it 1000:wrt
    709,"3,25"
239: "open cente
    r clamp":wait
    1000:wrt 709,
    "2,"
240: wait 1000
241: wrt 709,"C"
242: wait 500
243: ret
244: "field bias
    ":dsp "BIAS
    FIELD APPLICATI
    ON"
245: "preamp to
    null mode":
246: "10 oversted
    to bias coil
    1&2":
247: wrt 709,"3,
    30333435E":wrt
    709,"4,4449E"
248: wait 1000
249: "remove 10
    oversted field":
250: ".25 overste
    d to field coil
    1&2":
251: wrt 709,"3,
    303335E"
252: wait 1000
253: ret
254: "pressure
    data collection
    ":dsp "DATA
    COLLECTION IN
    PROCESS"
255: "preamp to
    gain mode":wait
    500
256: "turn on
    1HZ motor":
257: "set up
    pressure correl
    ation":
258: wrt 709,"3,
    263133354344460
    4E"
259: wrt 724,
    "T2"
260: 0+P:wait
    30000:wait 3000
    0:wait 30000:
    wait 15000
261: for 0=1 to
    100
262: red 724,V
263: V+P+P
264: wait 200
265: next 0
266: P/100+P[1]:
    14.14+P[1]+P[1]
267: "turn off
    1HZ motor":
268: wrt 709,"2,
    2021232449E"
269: ret

```

```

270: "magnetic
data collection
":dsp "DATA
COLLECTION IN
PROCESS"
271: "predmp to
gain mode":wait
500
272: "turn on
1HZ field":
273: "set up
magnetic correl
ation":
274: wrt 709,"4,
42444649,283133
3504E"
275: wrt 724,
"T2"
276: 0→M[100];
wait 30000;wait
15000
277: for 0=1 to
100
278: red 724,V
279: V+M[100]→M[
100]
280: wait 200
281: next 0
282: M[100]/100→
M[I];.1414*M[I]
+M[I]
283: "turn off
all fields":
284: wrt 709,"2,
2021232449E";
wait 100;wrt
709,"4,4449E"
285: ret
286: "N[I] posit
ioning":
287: "clear":wrt
709,"C"
288: "turn on
motor":
289: "close adva
nce clutch":
290: "turn on
null coil":
291: "predmp to
null mode":
292: wrt 709,"1,
00;3,36303338;
4.414446"

```

```

293: wrt 706,
"2100":wait
2000;wrt 709,
"4.414446"
294: "set up
SVM":wrt 724,
"D.0015S,N1S,
T2,R3"
295: "accelerate
advance motor"
:
296: fwt 2,f4.0,
z;2100→A
297: "acc motor"
:
298: "is measure
ment null near"
:if T+2=N[I];
sto "test null"
299: wrt 706.2,A
300: "read lenat
h":esb "length
measurement"
301: "is null
near":if L-W-
L[T-1]>25;esb
"null detect"
302: fwt 5,"TRAN
SPOSITION #",
f2.0," LENGTH
=",f5.1
303: if T>=2;
wrt .5,T+1,L[T-
1]-L[T-2]
304: if A>2998;
2998→A
305: A+1→A;sto
"acc motor"
306: "return":wr
t 709,"C"
307: ret
308: "length
measurement":
309: wrt 724,
"R3":wrt 709,
"01":wait 5
310: tra 724
311: red 724,r9
312: tra 724
313: red 724,V
314: if abs(V-
r9)>.5;jmp -4
315: 5.12→V→V

```

```

316: if V<.9*B;
sto "add 51.2
inches"
317: V→B;51.2→M+
V→L
318: ret
319: "add 51.2
inches":
320: V→B;M+1→M;
51.2→M+V→L
321: ret
322: "null detec
t":
323: "set up
SVM":wrt 724,
"D.0015S,N1S,
T2,R1"
324: wrt 709,
"00"
325: "cal null":
wait 5
326: red 724,r5
327: red 724,r6
328: red 724,r7
329: (r5+r6+r7)/
3→r5
330: red 724,V
331: if V/r5>0;
jmp -1
332: esb "length
measurement"
333: L-W→L[T];T+
1→T
334: beep
335: ret
336: "test null"
:
337: fwt 5,"SEEK
ING POSITION
#",f2.," FOR
TESTING"
338: wrt .5,N[I]
339: if B$="find
1":dsp "SEEKING
FINAL POSITION
"
340: fwt 2,f4.0,
z
341: wrt 724,
"T2"
342: "slow down
motor":wrt 706,
2,A

```

```

343: "read veloc
ity":wrt 709,
"02"
344: A-7>A;if
A<2100:2100>A
345: tra 724
346: red 724,V
347: if V/1:sto
"slow down moto
r"
348: asb "length
measurement"
349: "near null"
:if LIT-11+30<L
-W:jmp -1
350: "slow down"
:wrt 706,"2050"
351: asb "null"
352: "advance 2
inches to cente
r clamp":
353: "read initia
l length":asb
"length measure
ment"
354: L+R:L-W+LIT
J:T+1+T
355: if B$="fine
1":ret
356: wrt 709,
"3638"
357: "add 2 inch
es to length":
358: asb "length
measurement"
359: if L-R<1.9:
jmp -1
360: wrt 709,
"3E"
361: "TEST ST":1
f G$#"YES":dsp
"PRESS CONT'
TO CLAMP CABLE"
:beep:sto
362: asb "clampi
ng sequence"
363: if G$#"YES"
:dsp "PRESS
CONT' TO APPLY
FIELD BIAS":
beep:sto
364: wait 2000

365: asb "field
bias"
366: dsp "READY
FOR P/S DATA ":
beep:if G$#"YES"
:sto
367: wait 3000:
fmt 5,"CABLE
TRANS.#":+2.
368: spc
369: wrt 16.5,
M[I]
370: asb "pressu
re data collect
ion"
371: if obs(obs:
P[I])-.131>5:
sto "low pressu
re sensitivity"
372: fmt 3:+5.1,
"
"uu:lb"
373: prt " PRESS
URE SENS."
374: wrt 16.3,
P[I]
375: "magnet
ic test":
376: dsp "READY
FOR MAGNETIC
TEST":beep:wait
2000:if G$#"YE
S":sto
377: asb "magnet
ic data collect
ion"
378: if obs(obs:
M[I])-.21>.05:
sto "low magnet
ic sensitivity"
379: fmt 3:+5.2,
"
"uu:30000"
380: prt " MAGNE
TIC SENS."
381: wrt 16.3,
M[I]
382: "TEST ED":
383: asb "uncloa
ding sequence"
384: sto "return"
385: ret
386: "null":

387: wrt 709,
"00"
388: wrt 724,
"P1"
389: wait 500
390: for X=1 to
10
391: red 724,V
392: V+r5+r5
393: next X
394: r5/10+r5
395: red 724,V
396: if V/r5>0:
jmp -1
397: wrt 709,
"3E"
398: ret
399: "data reduc
tion":
400: "calculate
P/S mean":
401: 0+P[100]
402: for C=1 to
N
403: P[100]+obs:
P[C])+P[100]
404: next C
405: P[100]/N+P[
100]
406: "calculate
P/S std deviat
ion":
407: 0+P[99]
408: for C=1 to
N
409: P[99]+obs:
P[C])-P[100])^2
+P[99]
410: next C
411: obs(P[99]
(N-1))+P[99]
412: "calculate
MAG mean":
413: 0+M[100]
414: for C=1 to
N
415: M[100]+obs:
M[C])+M[100]
416: next C
417: M[100]/N+M[
100]

```

```

418: "calculate
MAG std deviation":
419: 0+M[99]
420: for C=1 to
N
421: M[99]+robs(M[99]
M[100]-M[100])/2
+M[99]
422: next C
423: robs(M[99]
(N-1)+M[99]
424: "calculate
distance between
n transposition
s mean":
425: 0+L[100]:
N+L[0]
426: for C=1 to
T-2
427: L[C+1]-L[C]
+L[100]+L[100]
428: next C
429: L[100]-T-
2)+L[100]
430: "calculate
distance between
n transposition
s std deviation
":
431: 0+L[99]
432: for C=1 to
T-2
433: L[99]+robs(L[C+1]-L[C]+
L[100])/2+L[99]
434: next C
435: robs(L[99]
(T-2)+L[99]
436: "test P+E
mean":
437: if obs(P[10
0]-13)/5:E+1+E
438: "test P+E
std deviation":
439: if P[99]:5:
E+1+E
440: "test MAG
mean":
441: if obs(M[10
0]-.3)/.05:E+
1+E

```

```

442: "test MAG
std deviation":
443: if M[99]:.0
5:E+1+E
444: "test total
# of transposi
tions":
445: if obs(T-
86)/1:E+1+E
446: "test disto
nce between
transpositions
mean":
447: if obs(L[10
0]-43)/1:E+1+E
448: "test disto
nce between
transpositions
std deviation":
449: if L[99]:1:
E+1+E
450: "test disto
nce between
transpositions"
:
451: for C=1 to
T-2
452: if obs(L[C+
1]-L[C]-43)/1:
E+1+E
453: next C
454: "test cable
length":
455: if obs(10-
3655)/75:E+1+E
456: "test DCP
change":if obs(
1-r2-r20)/.1:1+
E+E
457: "test IR
change":if obs(
1-r3-r30)/.1:1+
E+E
458: "print resu
lts":
459: spec:prt
"R & DATA RESUL
TS"
460: fmt 4,b,
"n=";f5.2;"un
its"
461: prt 16.4,
12,P[100]

```

```

462: wrt 16.4,9,
P[99]
463: spec:prt
"MAG DATA RESUL
TS"
464: fmt 4,b,
"n=";f5.2;"un
its"
465: wrt 16.4,
12,M[100]
466: wrt 16.4,9,
M[99]
467: spec:prt
"LENGTH RESULTS
"
468: fmt 4,b,
"d=";f4.1;"inc
hes"
469: wrt 16.4,
12,L[100]
470: wrt 16.4,9,
L[99]
471: spec:prt
"TRANSPPOSITIONS
TOTAL=";T+1
472: " test defe
cts":
473: if E>0:ato
"defect list"
474: spec 2
475: prt "####
#####
"
476: prt "##
TRANSDUCER ##":
prt "#### PASSE
D ####"
477: prt "####
#####
"
478: ret
479: "low magnet
ic sensitivity"
:beep
480: for Y=1 to
200:beep:wait
50:next Y
481: prt "RETEST
MAGNETIC TEST
C INPUT ?(N),C#
482: if C#="Y":
ato "RETEST"
483: if C#="Y":
ato "RETEST"

```

```

484: prt "SEN.
FAILURE"
485: "increment
# of defects":E
+1+E
486: ato "TEST
ED"
487: ret
488: "RETEST":
489: esb "uncloa
ding sequence"
490: dsp "READY
FOR CLAMPING
PRESS CONT":
beep:sto
491: esb "cloa
ding sequence"
492: wrt 709,
"30333435E"
493: wait 1000
494: wrt 709,"3,
3335E"
495: ato "no anet
ic test"
496: ret
497: low pressu
re sensitivity"
:beep
498: for Y=1 to
200:beep:wait
50:inc+Y
499: ent "RETEST
PRESSURE TEST
o INPUT Y N":C
500: if C#="N":
ato "retest"
501: if C#="Y":
ato "retest"
502: prt "BAD
P/S SEN.!!"
503: "increment
# of defects":E
+1+E
504: ato "no anet
ic test"
505: ret
506: "retest":
507: esb "uncloa
ding sequence"
508: ato "TEST
ST"
509: ret

```

```

510: "detect
list":
511: dsp "
TEST FAILUR
E"
512: for C=1 to
100:beep:inc C
513: spc 4:prt
"*****
#"
514: prt "##
TRANSDUCER ##"
515: prt "###
FAILED ###"
516: prt "*****
*****"
517: spc 2:prt
"TOTAL DEFECTS"
+E
518: spc 2:prt
" DEFECT LIST"
:spc
519: "test DCR":
520: if abs(1-
r2/r200).1:prt
"CHANGE IN DCR"
521: "test IR":
522: if abs(1-
r3/r300).1:prt
"CHANGE IN IR"
523: "test P/S
magnitude":
524: for C=1 to
N
525: if abs(obs1
P[C]-13).5:
prt "BAD P/S
AT TRP ",N[C]
526: next C
527: "test P/S
mean":
528: if abs(P[10
0]-13).5:prt
"BAD P/S MEAN"
529: "test P/S
std dev":
530: if P[99].5:
prt "HIGH P/S
STD DEV"
531: "test noa
magnitude":

```

```

532: for C=1 to
N
533: if abs(obs-
M[C]) > .2 > .05:
prt "BAD MAG
AT TRP":N[C]
534: next C
535: "test mag
mean":
536: if abs(M[10
0]-.2) > .05:prt
" BAD MAG MEAN"
537: "test mag
std dev":
538: if M[99] > .0
5:prt "HIGH
MAG STD DV"
539: "test dist
between trans."
:
540: for C=1 to
T-2
541: if abs(L[C+
1]-L[C]-43) > 1:
prt "DISTANCE
BETWEEN TRP INCO
RRECT AT":C
542: next C
543: "test disto
nce between
trans. mean":
544: if abs(L[10
0]-43) > 1:prt
" HIGH DISTANCE"
:prt "BETWEEN
TRP MEAN"
545: "test dis.
between trans.
std dev":
546: if L[99] > 1:
prt " HIGH
DISTANCE":prt
"BETWEEN TRP
S.D."
547: "test # of
trans.":
548: if abs(T-
99) > 1:prt
"INCORRECT #
OF":prt " TRANS
POSITIONS"
549: "test total
length":
550: if abs(T-
3655) > 75:prt "
CABLE LENGTH:
prt " INCORRE
CT"
551: ret
552: "Delta L":
553: for 8:"TRP#
":if 3.0:"L=":
+5.1
554: for U=1 to
T-2
555: sdc
556: wrt 16.8*U:
L[U+1]-L[U]
557: next U
+16359

```

APPENDIX C

PREAMP CALIBRATION PROGRAM LISTING

```

0: ent  PREAM-
  CAL"
1: new 724
2: wrt 724, 0.00
  15.435, 12.42
3: wrt 709, "0",
  "3133444605"
4: dsp  TERMINAT
  E PREAMP INPUT"
  :stop
5: dsp  "ALLOW
  PREAMP TO WARM
  UP FOR 2HR":
  stop
6: dsp  "ADJUST
  R30 UNTIL EEEP,
  THEN STOP":stop
7: "start":
8: for N=1 to
  1000
9: wait 20
10: tra 724
11: red 724,V
12: V+A+A
13: dsp  "VOLTMET
  ER READING =",
  A/N
14: next N
15: A/N+A
16: if abs(A)/.0
  2:0+A:sto "stor
  t"
17: for X=1 to
  50:beep:wait
  20:next X
18: ent  "OFFSET="
  "+A
19: dsp  "GAIN
  CHECK":0+A:stop
20: dsp  "ATTACH
  SCOPE PB TO
  OSC BO TER #4":
  stop
21: dsp  "ATTACH
  GROUND LEAD TO
  #22":stop
22: dsp  "ATTACH
  OTHER PROBE
  TIP TO JB1 #5":
  stop
23: wrt 709, "3",
  3133.4, 4546,
  05E"

```

```

24: wrt 724, "R2"
25: dsp  "REMOVE
  PREAMP TERMINAT
  ION":stop
26: dsp  "FROM
  TERMINAL #4
  OSC BOARD":stop
27: ent  "INPUT
  P-P SCOPE READI
  NG:asp 20V "+P
28: ent  "FROM
  JB1 #5 INPUT
  VOLTAGE P-P,
  10V",0
29: fmt 1, "GAIN="
  ", f5.1, "db"
30: wrt 16.1, 20+
  log(0/P)+112
31: spr :ent
  "GAIN=", 10+((11
  2+20*log(0/P))/
  20)
32: dsp  "PREAMP
  TEST COMPLETE"
33: end
+31408

```

APPENDIX D

FUNCTIONAL TEST PROGRAM LISTING

```

A: 10.1+r104;
1: 1.3+r101;.9+r10
2: 1.19+r103;.02+
r104;.01+r105
1: 40.1+r106;
.1+r107;.5+r108
2: 31w R#(16);
B#(16);C#(16);
D#(20);G#(16);
P(100);M(100);
L(0:100);T(16)
3: 31w N(100);
0+B;0+L(0);1-T
4: spc 2;prt ++
+++++++
5: prt "MILES
TRANSDUCER FUNC
TIONAL TEST"
6: prt "++++++"
+++++++;spc 2
7: prt "PRS mean
r100;prt "Pr
S mean L";r101;
prt "PRS sd L";
r102
8: prt "MAG mean
r103;prt
"MAG mean L";
r104;prt "MAG
sd L";r105
9: prt "In Ot
mean";r106;prt
"In mean L";
r107;prt "In
sd L";r108
10: spc 2;beep;
dsp " LOAD
SUPPLY REEL";
stp
11: beep;dsp "
ALIGN LEVEL
WINDER";stp
12: beep;dsp "
THREAD MILES
TRANSDUCER";
stp
13: prt 709;.1
14: beep;prt "
INPUT TODAY'S
DATE ";A#;if
A#="" ;jmp 0
15: spc 4;prt 16;
A#

```

```

16: beep;prt "
INPUT MILES
TRANSDUCER SEPI
AL #";B#;if
B#="" ;jmp 0
17: spc 4;prt 16;
"SERIAL #";B#;
spc 2
18: "A"+C#
19: if C#="A";
if C#="a";if
C#="m";if C#="M"
;jmp -1
20: if C#="A";
asb "AUTO"
21: if C#="a";
asb "AUTO"
22: if C#="M";
asb "MANUAL"
23: if C#="m";
asb "MANUAL"
24: prt "INPUT
AUTOMATIC SEQUE
NCING, Y#N";G#;
if G#="" ;jmp 0
25: if G#="Y";
if G#="Y";if
G#="N";if G#="n"
;jmp -1
26: if G#="Y";
dsp "AUTOMATIC
OPERATION SELEC
TED";beep;"YES"
+G#;stp
27: if G#="Y";
dsp "AUTOMATIC
OPERATION SELEC
TED";beep;"YES"
+G#;stp
28: dsp "PRESS
MOTOR CONTROL
START BUTTON";
stp
29: prt ":::::
:::::"
30: asb "measure
res"
31: beep;r2+r20;
r3+r30
32: dsp "INITIAL
POS.,PRESS CONT
INUE";beep;if
G#="YES";stp

```

```

33: asb "find
transposition
2"
34: dsp "N POSIT
IONING PRESS
CONT";beep;
if G#="YES";
stp
35: for I=1 to N
36: dsp "POSITIO
N # ";I;" IN
PROCESS"
37: asb "N(1)
positioning"
38: next I
39: dsp "FINAL
POSITIONING";
beep;if G#="YES"
;stp
40: spc 4;"final"
+B#
41: asb "final
positioning"
42: beep
43: dsp "READY
FOR REWIND";if
G#="YES";beep;
stp
44: asb "rewind"
45: dsp "READY
FOR DATA REDUC
TION";beep;if
G#="YES";stp
46: asb "measure
res"
47: asb "data
reduction"
48: "END";
49: prt 709;"C"
50: spc 4
51: dsp "XXXXXX
XXX END OF TEST
XXXXXXXX";
beep
52: end
53: "measure
res";
54: dsp "RES.
MEASUREMENT
ROUTINE,CONT";
beep;if G#="YES"
;stp

```

```

55: dsp "RES.
    MEASUREMENT IN
    PROCESS"
56: for X=1 to 3
57: if X=1:wrt
    709,"C","313245
    4703"
58: if X=2:wrt
    709,"C","313244
    4703"
59: if X=3:wrt
    709,"C","303244
    4703"
60: clr 723:wait
    500
61: tra 723:red
    723.0
62: clr 723:wait
    500
63: tra 723:red
    723.0$
64: val10#1+10*
    al10#181+0
65: if X=1:0+r1
66: if X=2:0+r2
67: if X=3:0+r3
68: next X
69: "SLIPPING
    MEASUREMENT":
70: r1+5
71: if S=5:ato
    "BAD SLIPPING"
72: ato "DCR"
73: "BAD SLIPRI
    NG":
74: prt "    DEFE
    CTIVE "prt "
    SLIPRING"
75: prt "    TEST
    ABORTED"
76: dsp "%%%%":
    DEFECTIVE SLIPP
    INGS %%%%"
77: for O=0 to
    200
78: beep:wait 50
79: next O
80: end
81: "DCR":
82: dsp "    CABLE
    RES. MEASURE
    IN PROCESS"

```

```

83: if abs(r2-
    2651720:ato
    "BADDCR"
84: fwt 6:"DCR"
    = "+f3.0," ".b
85: wrt 16.6*r2.
    17
86: "IP MEASUREM
    ENT":
87: if r3.1e7:
    ato "BADIR"
88: if r3.1.9e7:
    19000000+r3
89: fwt 6:"IP" =
    "+f9.0," ".b
90: wrt 16.6*r3.
    17
91: ret
92: "BADIR":
93: for Y=1 to
    200:beep:wait
    50:next Y
94: ent "RETEST
    CABLE DCR&IR"
    INPUT Y/N",A$
95: if A$#"Y":
    if A$#"Y"iE+
    1+E:ato "TESTFA
    IL"
96: prt "RES.
    RETEST"
97: ato "measure
    res"
98: ret
99: "BADDCR":
100: for Y=1 to
    200:beep:wait
    50:next Y
101: ent "RETEST
    CABLE DCR&IR"
    INPUT Y/N",A$
102: if A$#"Y":
    if A$#"Y"iE+
    1+E:ato "TESTFA
    IL"
103: prt "RES.
    RETEST"
104: ato "measure
    res"
105: ret
106: "TESTFAIL":
107: spc 2
108: prt "TEST
    FAILURE 1":spc

```

```

109: fwt f3.0
110: wrt 16,"#
    OF FAILURES":E:
    spc
111: dsp "<<<<
    TRANSDUCER TEST
    FAILED >>>>"
112: beep
113: end
114: "BADDCR":
115: ent "RETEST
    DCR INPUT Y/
    N",A$
116: if A$#"Y":
    if A$#"Y"iE+
    1+E:ato "TESTFA
    IL"
117: spc 1prt
    "DCR RETEST"
118: ato "dortes
    t"
119: ret
120: "BADIR":
121: ent "RETEST
    IR INPUT Y/N",
    A$
122: if A$#"Y":
    if A$#"Y"iE+
    1+E:ato "TESTFA
    IL"
123: spc 1prt
    "IR RETEST"
124: ato "irtest
    "
125: ret
126: "find trans
    position 2":
127: dsp "SEEKIN
    G INITIAL POSITI
    ON"
128: wrt 706,
    "2000"
129: "close adv
    clutch":
130: "set predamp
    to null mode":
131: "turn on
    null coil":
132: "1in/sec
    to end motor":
133: "turn motor
    on":
134: fwt 4:c;z

```

```

135: wrt 709,
    "C", "3033363841
    444600"
136: "set up
    SVM":wrt 724,
    "0.00158,N19,
    T2,R1"
137: wait 1000
138: wrt 706.4,
    "2100"
139: "calculate
    null":
140: red 724,V
141: if V>.06:
    jmp -1
142: red 724,r4
143: red 724,r5
144: red 724,r6
145: (r4+r5+r6)/
    3+r4
146: red 724,V
147: if V<r4.0:
    jmp -1
148: "found null
    ,read length":
149: wrt 709,
    "C", "4601"
150: asb "length
    measurement"
151: L+W
152: ret
153: "final posi
    tioning":
154: 86+N[1]:N+
    1+I
155: prt "FINAL
    POSITION"
156: asb "N[1]
    positioning"
157: ret
158: "rewind":
159: "clear":wrt
    709,"C"
160: 1+I:wait
    500
161: wrt 724,
    "R2T1"
162: "measure
    final length":
163: "setup rew
    ind motor":prt
    709,"3.39373"

```

```

164: "setup rew
    ind motor":
165: asb "length
    measurement"
166: L-W+0
167: fwt 2,+4.0,
    Z
168: 2100+A
169: "turn on
    rewind motor":w
    rt 709,"3.39373
    033:4.4446"
170: "measure
    L":asb "length
    measurement"
171: dsp "CABLE
    LENGTH = ".2+0-
    L+W," IN."
172: if L-W+300>
    2+0:-3+K
173: if L>2+0-
    25:wrt 709,"C":
    ret
174: if A>2998:
    2998+A
175: if A<2200:
    2200+A
176: A+K+A
177: wrt 706.2,A
178: ato "measur
    e L"
179: ret
180: "MANUAL":
181: dsp "MANUAL
    TEST POINTS
    SELECTION":beep
    :stp
182: ent "INPUT
    # OF DESIRED
    TEST POINTS",N:
    beep:if N=1:
    jmp 0
183: if N=86:
    dsp "TEST POIN
    T MUST < 86":
    beep:stp :jmp -
    1
184: if N=1:ato
    "one test pt"
185: for I=1 to
    N
186: beep

```

```

187: if I#1:jmp
    2
188: ent "INPUT
    FIRST TEST POIN
    T LOCATION",
    N[1]
189: if I#N:jmp
    2
190: ent "INPUT
    LAST TEST POINT
    LOCATION",N[1]
191: if I=1:jmp
    5
192: if I=N:jmp
    2
193: ent "INPUT
    NEXT TEST POINT
    LOCATION",N[1]
194: if N[1]>N[1]
    -1:jmp 2
195: beep:dsp
    "TEST PT MUST
    EXCEED PREVIOUS
    PT":stp :jmp -
    6
196: if N[1]<=2:
    dsp "FIRST TEST
    POINT MUST BE
    > 2":beep:stp :
    jmp -10
197: if N[1]>=86
    :dsp "TEST
    POINT LOCATION
    <86":beep:stp :
    jmp -11
198: next I
199: ret
200: "one test
    pt":
201: ent "INPUT
    TEST POINT LOCA
    TION",N[1]
202: if N[1]<=2:
    dsp "TEST POINT
    MUST BE > 2":
    beep:stp :jmp -
    2
203: if N[1]>=85
    :dsp "TEST POIN
    T MUST BE< 86":
    beep:stp :jmp -
    3
204: ret

```

```

205: "AUTO":
206: dsp "AUTOMA
TIC MODE SELECT
ED";beep;stp
207: dsp "PTS:
10/40/60/80
WILL BE TESTED"
;beep;stp
208: 10+N[1];
40+N[2];60+N[3]
;80+N[4]
209: 4+N
210: ret
211: "transposit
ion test":
212: wrt 709,"C"
213: wrt 709,
"46"
214: wrt 706,
"2000"
215: dsp "N POSI
TIONING ";beep
;if G##"YES":
stp
216: for I=1 to
N
217: asb "N[I]
positioning"
218: beep
219: next I
220: dsp "FINAL
POSITIONING ";
beep;if G##"YES"
;stp
221: "clamping
sequence":dsp
"CLAMPING PROCE
DURE IN PROCESS"
222: wrt 709,
"C","494602"
223: "is velocity
y=0":wait 50
224: tra 724
225: red 724,V
226: if V>.05:
jmp -1
227: wait 1000
228: "zero mech"
:wait 750;wrt
709,"25";wrt
709,"4.49"
229: "close stat
ionary":wait
750;wrt 709,
"20"
230: "close tens
ion clamp":wait
750;wrt 709,
"21"
231: "appl: tens
ion":wait 750;
wrt 709,"22"
232: "close tens
ion brake":wait
750;wrt 709,
"23"
233: "relax tens
ion":wait 750;
wrt 709,"2,2021
2325"
234: "close cent
er clamp":wait
750;wrt 709,
"24"
235: "relax zero
mech":wait
750;wrt 709,"2,
20212324"
236: ret
237: "unclamping
sequence":dsp
"UNCLAMPING
PROCEDURE IN
PROCESS"
238: wait 1000
239: "open cente
r clamp":wrt
709,"2,202123"
240: "appl: zero
mech":wait
1000;wrt 709,
"2,20212325"
241: "open tensi
on brake clamp"
:wrt 709,"2,2025
"
242: "open stat1
ionary clamp":wa
it 1000;wrt
709,"2,25"
243: "open cente
r clamp":wait
1000;wrt 709,
"2,"
244: wait 1000
245: wrt 709,"C"
246: wait 500
247: ret
248: "field bias
":dsp "BIAS
FIELD APPLICATI
ON"
249: "preamp to
null mode":
250: "10 overste
d to bias coil
102":
251: wrt 709,"3,
30333435E";wrt
709,"4,4449E"
252: wait 1000
253: "remove 10
overste field":
254: ".25 overste
d to field coil
s 102":
255: wrt 709,"3,
303335"
256: wait 1000
257: ret
258: "pressure
data collection
":dsp "DATA
COLLECTION IN
PROCESS"
259: "preamp to
gain mode":wait
500
260: "turn on
1HZ motor":
261: "set up
pressure correl
ation":
262: wrt 709,"3,
263133354344460
4E"
263: wrt 724,
"12"
264: 0+P;wait
30000;wait 3000
0;wait 30000;
wait 15000
265: for 0=1 to
100
266: red 724,V
267: V+P+P
268: wait 200

```

```

269: next 0
270: P:=100+P[I];
    14.14+P[I]+P[I]
271: "turn off
    1HZ motor":
272: wrt 709,"2,
    2021232449E"
273: ret
274: "magnetic
    data collection
    ":dsp "DATA
    COLLECTION IN
    PROCESS"
275: "prepare to
    spin mode":wait
    500
276: "turn on
    1HZ field":
277: "set up
    magnetic correl
    ation":
278: wrt 709,"4,
    42444649,283133
    3504E"
279: wrt 724,
    "T2"
280: 0+M[100];
    wait 30000;wait
    15000
281: for 0=1 to
    100
282: red 724,V
283: V+M[100]+M[
    100]
284: wait 300
285: next 0
286: M[100]/100+
    M[I];.1414*M[I]
    +M[I]
287: "turn off
    all fields":
288: wrt 709,"2,
    2021232449E":
    wait 100;wrt
    709,"4,4449E"
289: ret
290: "N[I] posit
    ioning":
291: "clear":wrt
    709,"0"
292: "turn on
    motor":

```

```

293: "close adva
    nce clutch":
294: "turn on
    null coil":
295: "prepare to
    null mode":
296: wrt 709,"1,
    00;3,36303338;
    4,414446"
297: wrt 706,
    "2100";wait
    2000;wrt 709,
    "4,414446"
298: "set up
    SVM":wrt 724,
    "0.0015S,N1S,
    T2,R3"
299: "accelerate
    advance motor"
    :
300: fmt 2,f4.0,
    z:2100+A
301: "acc motor"
    :
302: "is measure
    ment null near"
    :if T+2=N[I];
    goto "test null"
303: wrt 706,2,A
304: "read lenet
    h":asb "length
    measurement"
305: "is null
    near":if L-W-
    L[T-1]>25;asb
    "null detect"
306: fmt 5,"TRAN
    SPOSITION #",
    f2.0," LENGTH
    =" ,f5.1
307: if T>=2;
    wrt .5,T+1,L[T-
    1]-L[T-2]
308: if A>2998;
    2998+A
309: A+1+A;goto
    "acc motor"
310: "return":wr
    t 709,"0"
311: ret
312: "length
    measurement":

```

```

313: wrt 724,
    "R3";wrt 709,
    "01";wait 5
314: tr9 724
315: red 724,r9
316: tr9 724
317: red 724,V
318: if abs(V-
    r9)>.5;jmp -4
319: 5.12*V+V
320: if V<.9*B;
    goto "add 51.2
    inches"
321: V+B;51.2*M+
    V+L
322: ret
323: "add 51.2
    inches":
324: V+B;M+1+M;
    51.2*M+V+L
325: ret
326: "null detec
    t":
327: "set up
    SVM":wrt 724,
    "0.0015S,N1S,
    T2,R1"
328: wrt 709,
    "00"
329: "cal null":
    wait 5
330: red 724,r5
331: red 724,r6
332: red 724,r7
333: (r5+r6+r7)/
    3+r5
334: red 724,V
335: if V/r5>0;
    jmp -1
336: asb "length
    measurement"
337: L-W+L[T];T+
    1+T
338: beep
339: ret
340: "test null"
    :
341: fmt 5,"SEEK
    ING POSITION
    #",f2.," FOR
    TESTING"
342: wrt .5,N[I]

```

```

343: if B$="final"
1" idsp "SEEKING
FINAL POSITION
"
344: fmt 2,f4.0,
z
345: wrt 724,
"T2"
346: "slow down
motor":wrt 706,
2,A
347: "read veloc
ity":wrt 709,
"02"
348: A-7→A;if
A<2100:2100→A
349: trs 724
350: red 724,V
351: if V>1:sto
"slow down moto
r"
352: esb "length
measurement"
353: "near null"
:if L[T-1]+30<L
-W: jmp -1
354: "slow down"
:wrt 706,"2050"
355: esb "null"
356: "advance 2
inches to cente
r clamp":
357: "read initia
l length":esb
"length measure
ment"
358: L→R;L-W→L[T
];T+1→T
359: if B$="final"
1:ret
360: wrt 709,
"3638"
361: "add 2 inch
es to length":
362: esb "length
measurement"
363: if L-R<1.9:
jmp -1
364: wrt 709,
"3E"
365: "TEST ST":i
f G$#"YES":dsp
"PRESS CONT"

```

```

TO CLAMP CABLE"
ibeep:sto
366: esb "clampi
ng sequence"
367: if G$#"YES"
idsp "PRESS
CONT' TO APPLY
FIELD BIAS":
beep:sto
368: wait 2000
369: esb "field
bias"
370: dsp "READY
FOR P/S DATA ":
beep;if G$#"YES"
:sto
371: wait 2000:
fmt 5,"CABLE
TRANS.#":f2.
372: spc
373: wrt 16.5,
N[I]
374: esb "pressu
re data collect
ion"
375: if abs(abs(
P[I])-13)>1000:
sto "low pressu
re sensitivity"
376: fmt 3,f5.1,
"uv/lb"
377: wrt "PRESS
URE SENS."
378: wrt 16.3,
P[I]
379: "magnetic
test":
380: dsp "READY
FOR MAGNETIC
TEST":ibeep:wait
2000:if G$#"YE
S":sto
381: esb "magnet
ic data collect
ion"
382: if abs(abs(
M[I])-2)>1000:
sto "low magnet
ic sensitivity"
383: fmt 3,f5.2,
"uv/gamma"
384: wrt "MAGNE
TIC SENS."

```

```

385: wrt 16.3,
M[I]
386: "TEST ED":
387: esb "uncloa
ping sequence"
388: sto "return"
"
389: ret
390: "null":
391: wrt 709,
"00"
392: wrt 724,
"R1"
393: wait 500
394: for X=1 to
10
395: red 724,V
396: V+r5-r5
397: next X
398: r5/10+r5
399: red 724,V
400: if V/r5>0:
jmp -1
401: wrt 709,
"3E"
402: ret
403: "data reduc
tion":
404: "calculate
P/S mean":
405: 0→P[100]
406: for C=1 to
N
407: P[100]+abs(
P[C])+P[100]
408: next C
409: P[100]/N→P[
100]
410: "calculate
P/S std deviat
ion":
411: 0→P[99]
412: for C=1 to
N
413: P[99]+(abs(
P[C])-P[100])2
→P[99]
414: next C
415: abs(P[99]/
(N-1))→P[99]
416: "calculate
MAG mean":
417: 0→M[100]

```

```

418: for C=1 to
N
419: M[100]+abs(
M[C])-M[100]
420: next C
421: M[100]/N+M[
100]
422: "calculate
MAG std deviat
on":
423: 0+M[99]
424: for C=1 to
N
425: M[99]+(abs(
M[C])-M[100])^2
+M[99]
426: next C
427: rabs(M[99]/
(N-1))+M[99]
428: "calculate
distance betwee
n transposition
s mean":
429: 0+L[100]:
W+L[0]
430: for C=1 to
T-2
431: L[C+1]-L[C]
+L[100]+L[100]
432: next C
433: L[100]/(T-
2)+L[100]
434: "calculate
distance betwee
n transposition
s std deviation
":
435: 0+L[99]
436: for C=1 to
T-2
437: L[99]+(abs(
L[C+1]-L[C])-
L[100])^2+L[99]
438: next C
439: rabs(L[99]/
(T-3))+L[99]
440: "test P/S
mean":
441: if abs(P[10
0]-r100)>r101:
E+1+E
442: "test P/S
std deviation":
443: if P[99]>r1
02:E+1+E
444: "test MAG
mean":
445: if abs(M[10
0]-r103)>r104:
E+1+E
446: "test MAG
std deviation":
447: if M[99]>r1
05:E+1+E
448: "test total
# of transposi
tions":
449: if abs(T-
86)>1:E+1+E
450: "test dista
nce between
transpositions
mean":
451: if abs(L[10
0]-r106)>r107:
E+1+E
452: "test dista
nce between
transpositions
std deviation":
453: if L[99]>r1
08:E+1+E
454: "test dista
nce between
transpositions"
:
455: for C=1 to
T-2
456: if abs(L[C+
1]-L[C]-43)>1:
E+1+E
457: next C
458: "test cable
length":
459: if abs(Q-
3655)>75:E+1+E
460: "test DCR
change":if abs(
1-r2/r20)>.1:1+
E+E
461: "test IP
change":if abs(
1-r3/r30)>.1:1+
E+E
462: "print resu
lts":
463: spc ;prt
"P/S DATA RESUL
TS"
464: fmt 4,b,
"s=",f5.1,"uv/
lb"
465: wrt 16.4,
12,P[100]
466: wrt 16.4,9,
P[99]
467: spc ;prt
"MAG DATA RESUL
TS"
468: fmt 4,b,
"m=",f5.2,"uv/
gamma"
469: wrt 16.4,
12,M[100]
470: wrt 16.4,9,
M[99]
471: spc ;prt
"LENGTH RESULTS
"
472: fmt 4,b,
"d=",f4.1,"inc
hes"
473: wrt 16.4,
12,L[100]
474: wrt 16.4,9,
L[99]
475: spc ;prt
"TRANSPPOSITIONS
TOTAL=",T+1
476: " test defe
cts":
477: if E>0:go
"defect list"
478: spc 2
479: prt "#####
#####"
480: prt "$$
TRANSDUCER $$";
prt "$$$$ PASSE
D $$$"
481: prt "#####
#####"
482: ret
483: "low magnet
ic sensitivity"
:beep
484: for Y=1 to
200:beep:wait
50:next Y

```

```

485:  ent "RETEST
      MAGNETIC TEST
      ? INPUT Y/N":C#
486:  if C#="Y":
      ato "RETEST"
487:  if C#="Y":
      ato "RETEST"
488:  prt "SEN.
      FAILURE"
489:  "increment
      # of defects":E
      +1+E
490:  ato "TEST
      ED"
491:  ret
492:  "RETEST":
493:  asb "uncloa
      ping sequence"
494:  dsp "READY
      FOR CLAMPING
      PRESS CONT":
      beep:stp
495:  asb "clampi
      ng sequence"
496:  wrt 709,"3,
      30333435E"
497:  wait 1000
498:  wrt 709,"3,
      3035E"
499:  ato "magnet
      ic test"
500:  ret
501:  "low pressu
      re sensitivity":
      beep
502:  for Y=1 to
      300:beep:wait
      50:next Y
503:  ent "RETEST
      PRESSURE TEST
      ? INPUT Y/N":C#
504:  if C#="Y":
      ato "retest"
505:  if C#="Y":
      ato "retest"
506:  prt "BAD
      P/S SEN.!!"
507:  "increment
      # of defects":E
      +1+E
508:  ato "magnet
      ic test"
509:  ret

```

```

510:  "retest":
511:  asb "uncloa
      ping sequence"
512:  ato "TEST
      ST"
513:  ret
514:  "defect
      list":
515:  dsp "xxxxx
      TEST FAILURE
      E:00000000"
516:  for C=1 to
      100:beep:next C
517:  spc 4:prt
      "#####
      ##"
518:  prt "##
      TRANSDUCER ##"
519:  prt "####
      FAILED ####"
520:  prt "#####
      #####"
521:  spc 2:prt
      "TOTAL DEFECTS"
      ,E
522:  spc 2:prt
      " DEFECT LIST"
      :spc
523:  "test DCR":
524:  if abs(1-
      r2/r20)>.1:prt
      "CHANGE IN DCR"
525:  "test IR":
526:  if abs(1-
      r3/r30)>.1:prt
      "CHANGE IN IR"
527:  "test P/S
      magnitude":
528:  for C=1 to
      N
529:  if abs(abs(
      P[C])-10)>5:
      prt "BAD P/S
      AT TRF "+N[C]
530:  next C
531:  "test P/S
      mean":
532:  if abs(P[10
      0]-r100)>r101:
      prt "BAD P/S
      MEAN"
533:  "test P/S
      std dev":

```

```

534: if P[99] > 1
535:   print "HIGH P
536:   S STD DV"
537: "test mag
538: magnitude":
539: for C=1 to
540:   N
541:   if abs(obs1
542:     M[C]-.2)>.05:
543:     print "BAD MAG
544:     AT TRP",N[C]
545:   next C
546: "test mag
547: mean":
548: if abs(M[10
549:   0]-r103)/r104:
550:   print "BAD MAG
551:   MEAN"
552: "test mag
553: std dev":
554: if M[99]>r1
555:   05:print "HIGH
556:   MAG STD DV"
557: "test dist
558: between trans.
559: ":
560: for C=1 to
561:   T-2
562:   if abs(L[C+
563:     1]-L[C]-43)>1:
564:     print "DISTANCE
565:     BETWEEN TRP INCO
566:     RRECT AT",C
567:   next C
568: "test dista
569: nce between
570: trans. mean":
571: if abs(L[10
572:   0]-r106)/r107:
573:   print "HIGH
574:   DISTANCE":print
575:   "BETWEEN TRP
576:   MEAN"
577: "test dis.
578: between trans.
579: std dev":
580: if L[99] > 1
581:   08:print "HIGH
582:   DISTANCE":print
583:   "BETWEEN TRP
584:   S.D."
585: "test # of
586: trans.":
587: if obs(T-
588:   98)-1:print "
589:   INCORRECT #

```

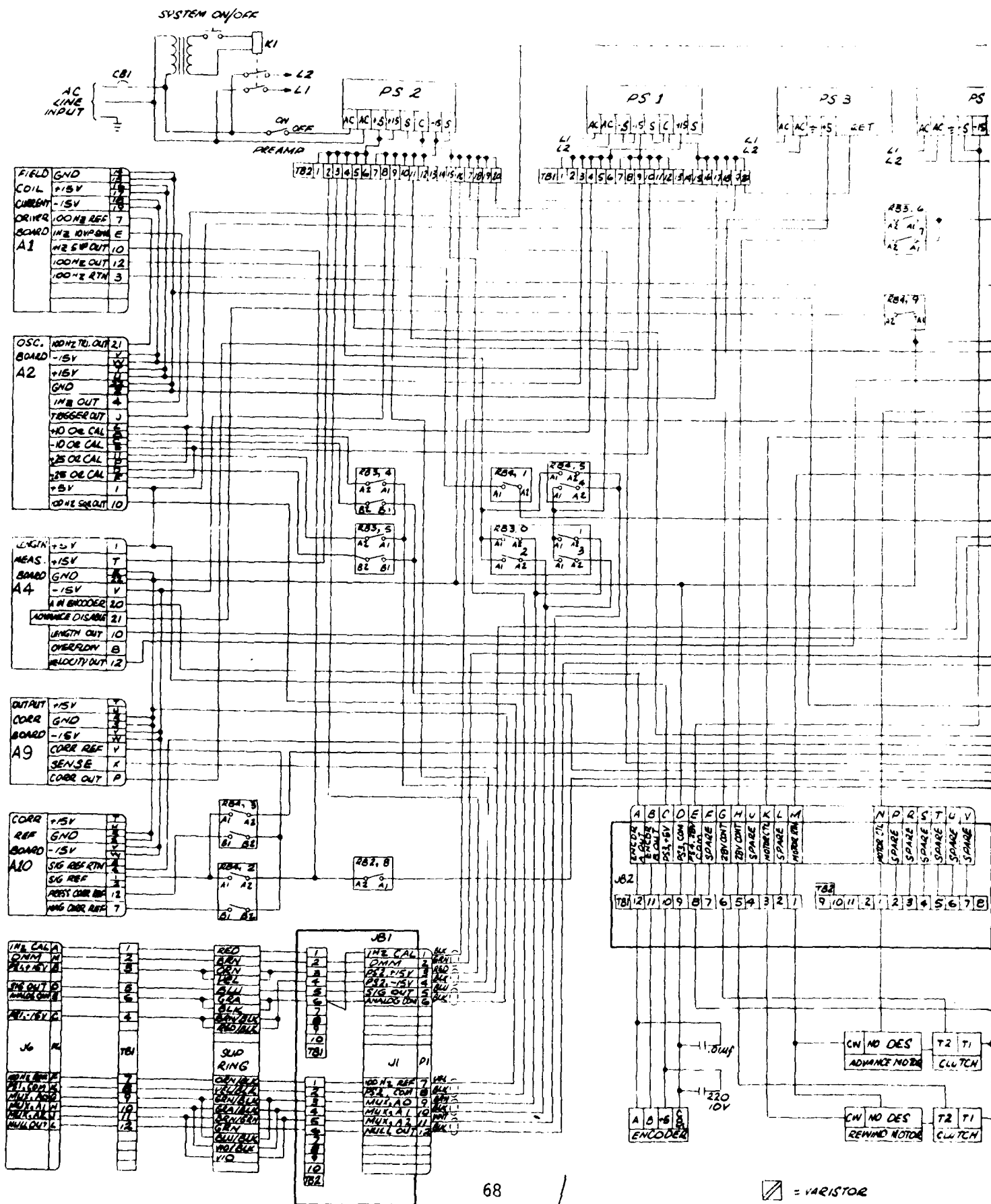
```

OF:print " TRANS
POSITIONS"
553: "test total
length":
554: if abs(10-
3655)/.75:print "
CABLE LENGTH":
print " INCORPE
CT"
555: ret
556: "Delta L":
557: fnt 8,"TRP#
",+3.0,"L=",
+5.1
558: for U=1 to
T-2
559:   sdc
560:   wrt 16.8*U,
LCU+11-L[U]
561: next U
+18943

```

APPENDIX E

SCHEMATICS



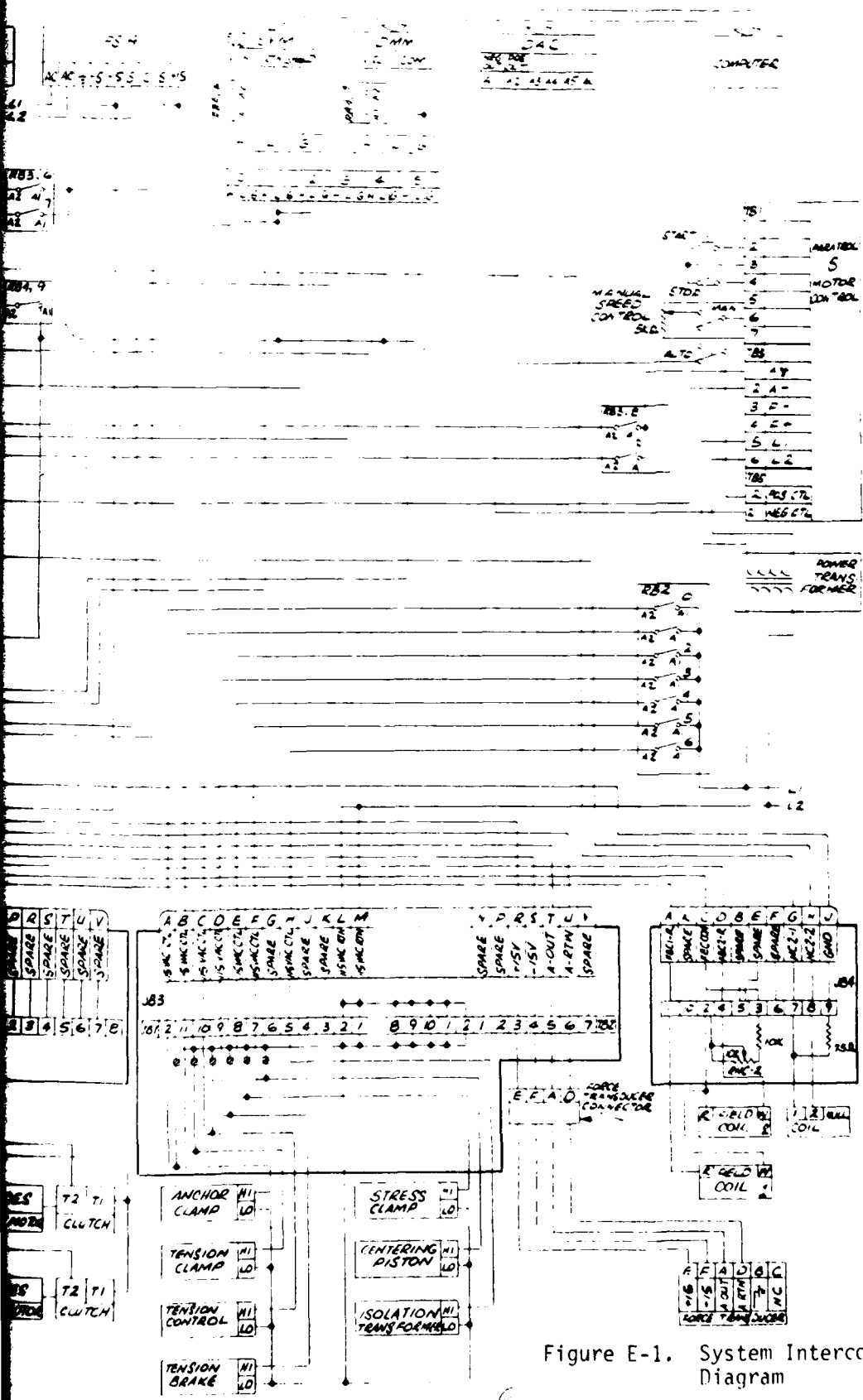
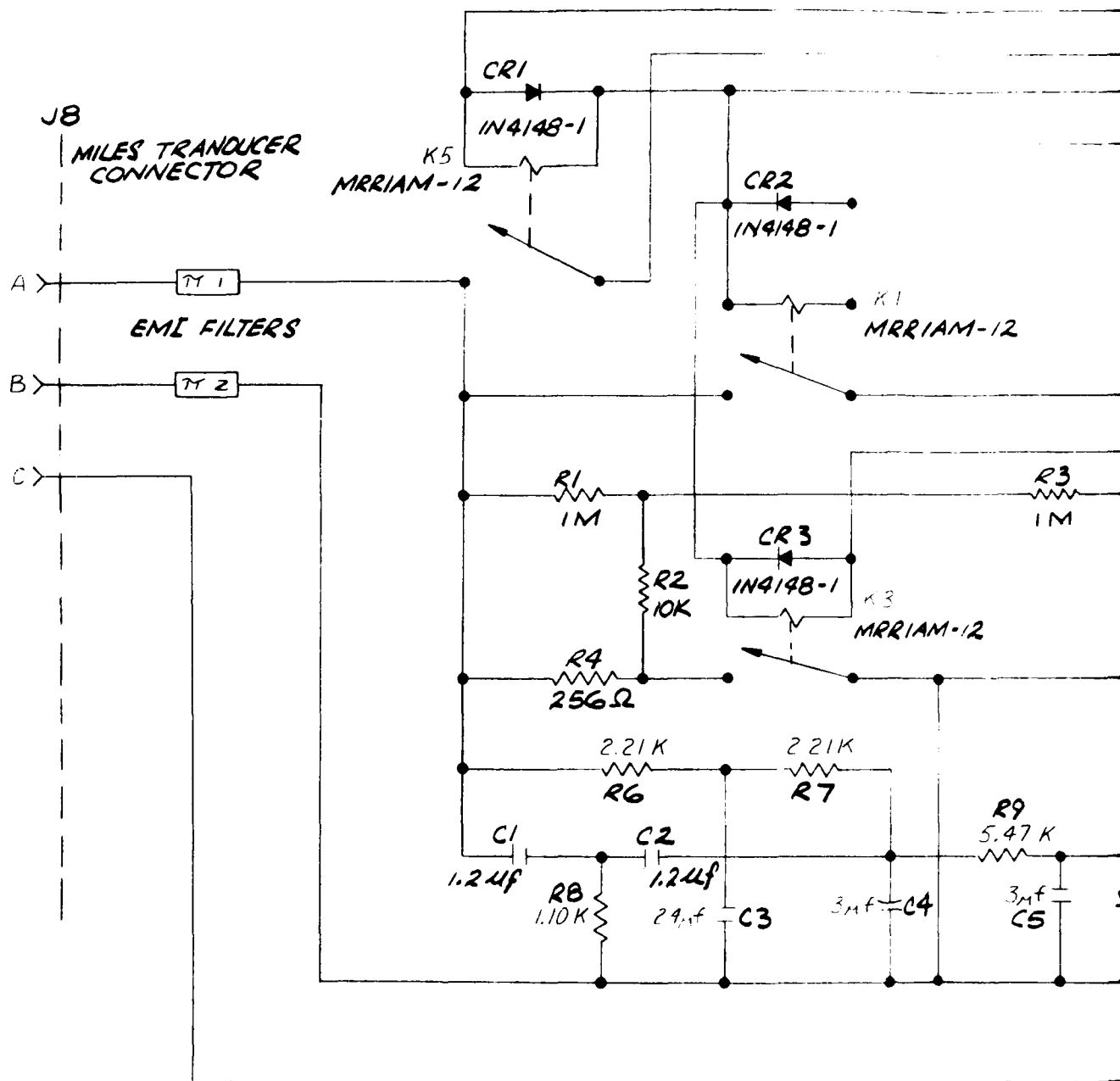


Figure E-1. System Interconnect Diagram



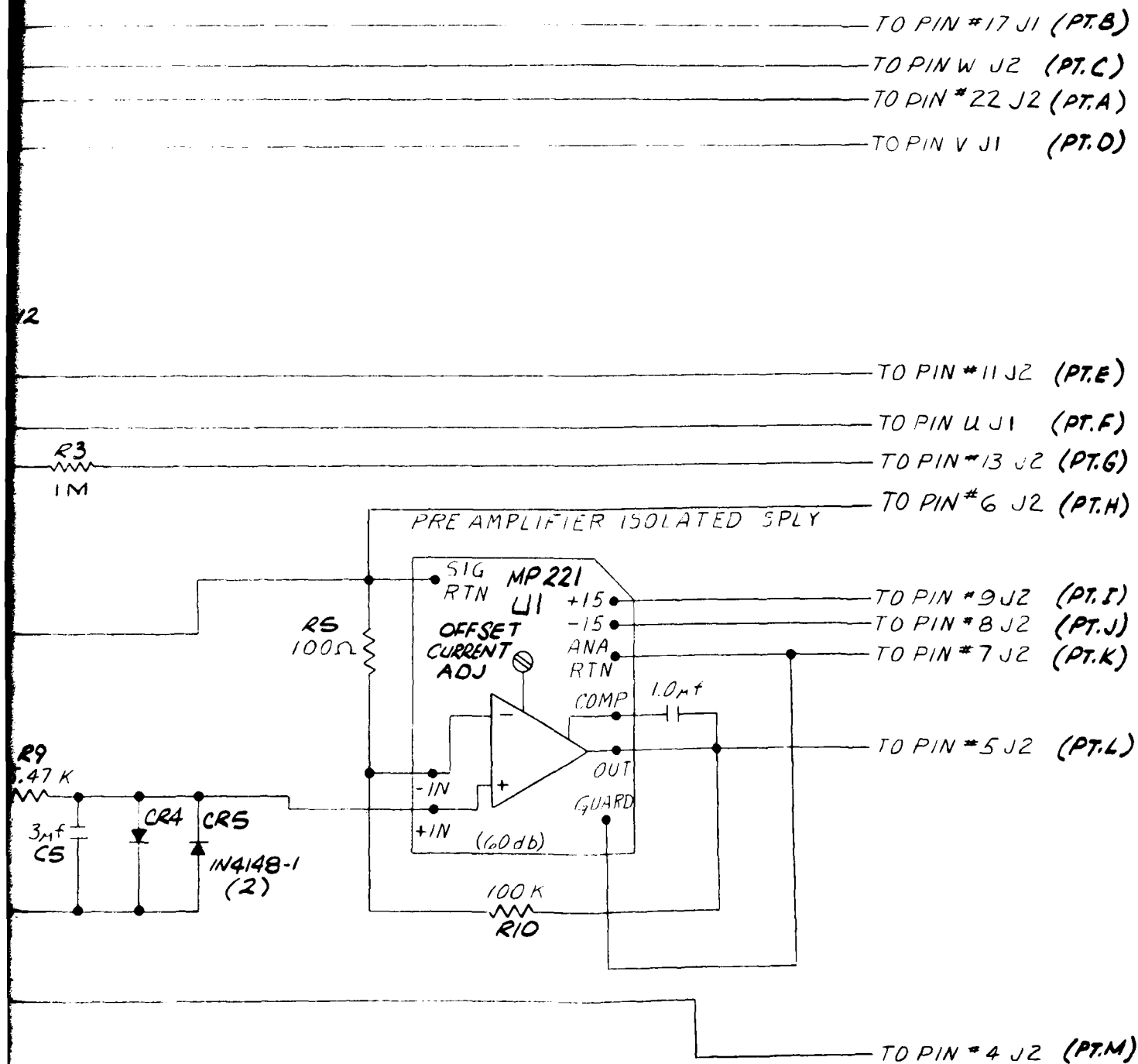
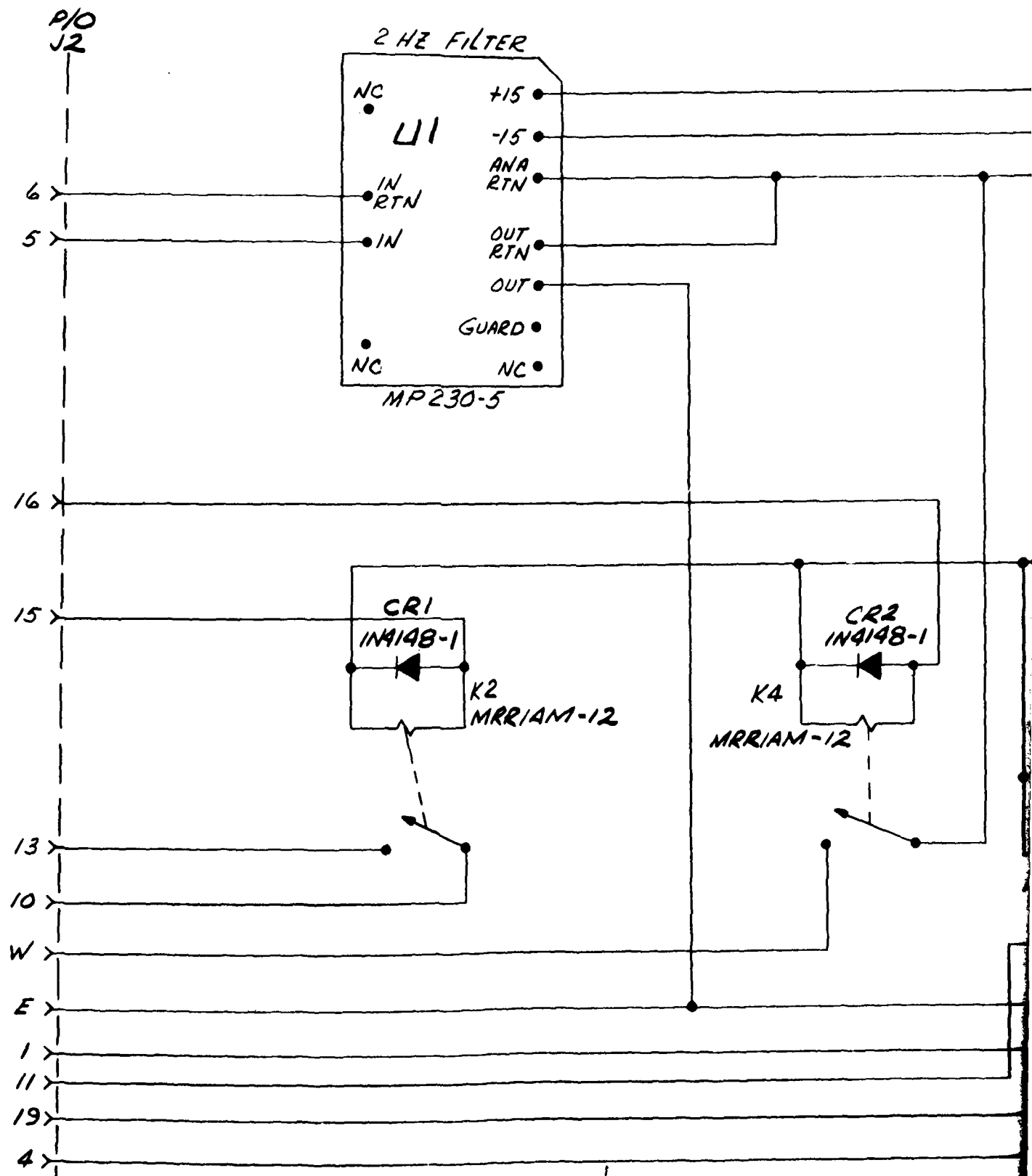


Figure E-2. Preamp Schematic



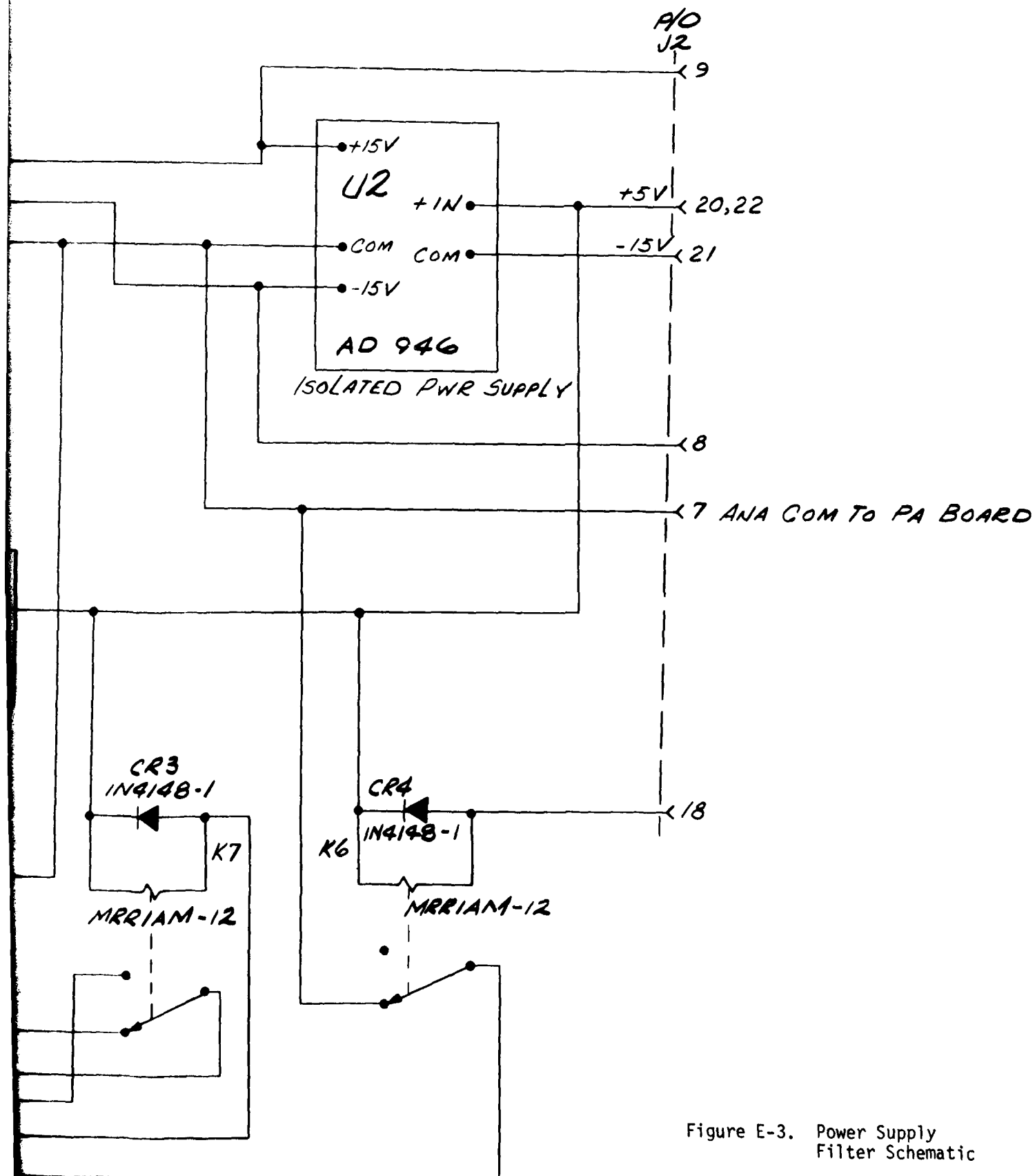
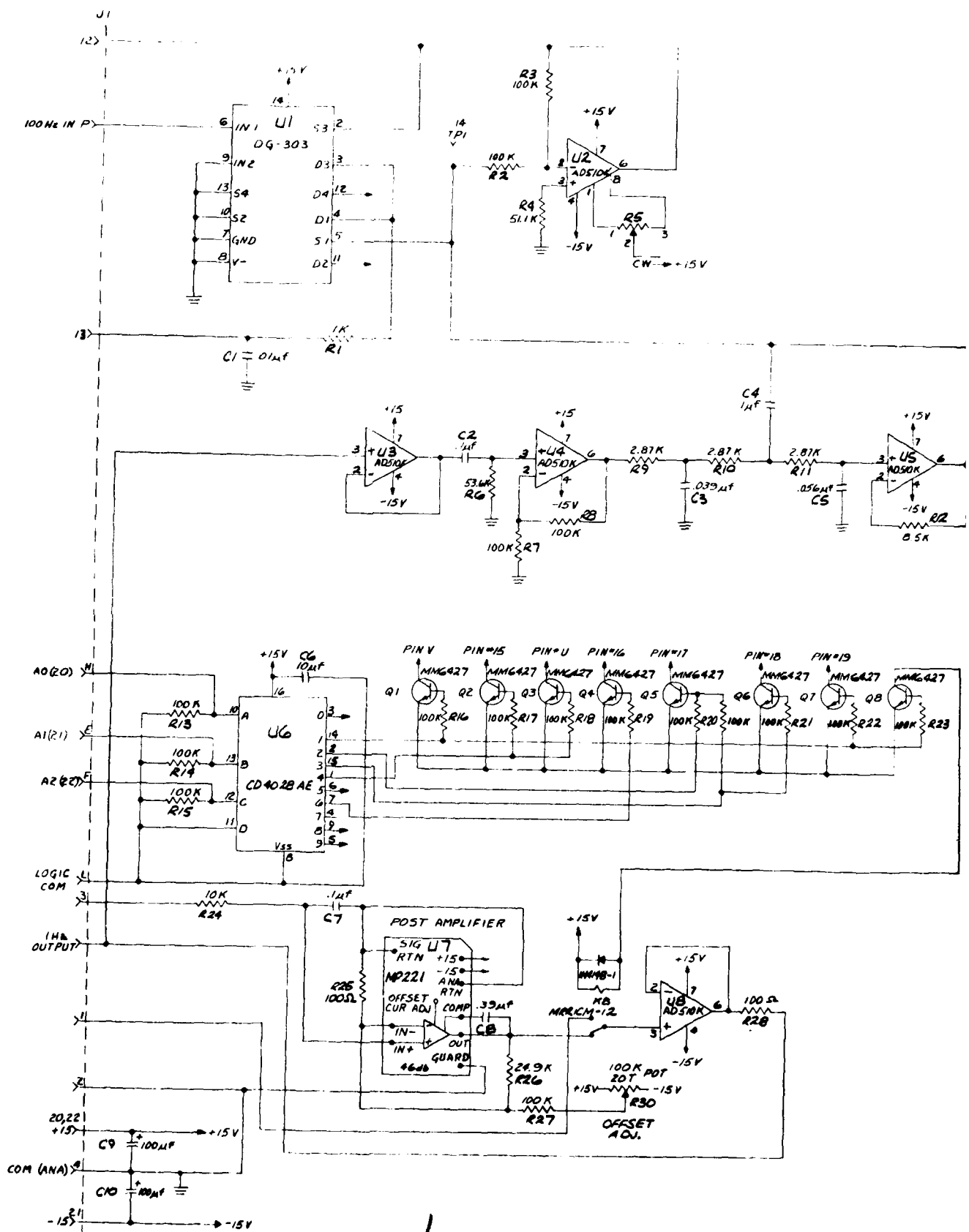


Figure E-3. Power Supply Filter Schematic



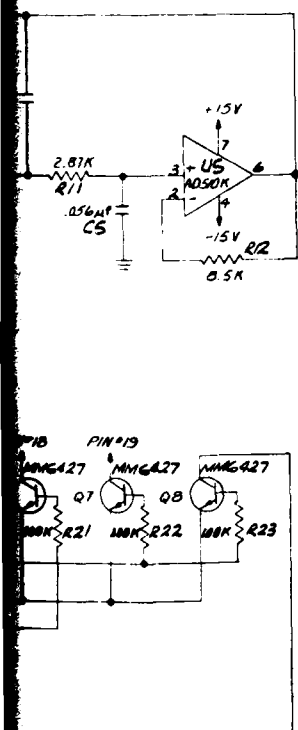


FIGURE E-4. Amplifier, Mux, Null
Detector Schematic

SEE FIG 7-4

P1	
N/C	12
100 HZ IN	P
NULL OUT	13
A0	H
A1	E
A2	F
LOGIC COM	L
FILTER 2HZ OUT	3
1 HZ OUT	D
K7 WIP	1
ANA	2
COMM	4
+15	22
-15	21
Q1	V
Q2	15
Q3	U
Q4	16
Q5	17
Q6	18
Q7	19

SEE FIG 7-3

P/A RTN	6
K6 WIP	4
P/A OUT	5
K4 CON	16
K2 CON	15
K7 CON	19
K6 CON	18
K7 NO	11
-15 ISO	8
+15 ISO	9
+15 IN	20
-15 IN	21
K2 WIP	10
K2 NO	13
K4 NO	W
K7 WIP	1
2 HZ FILTER	E
K6 NC	7

A B C D E F G H J K L

773 774 775 776 777 778 779 7710 7711 7712 7713

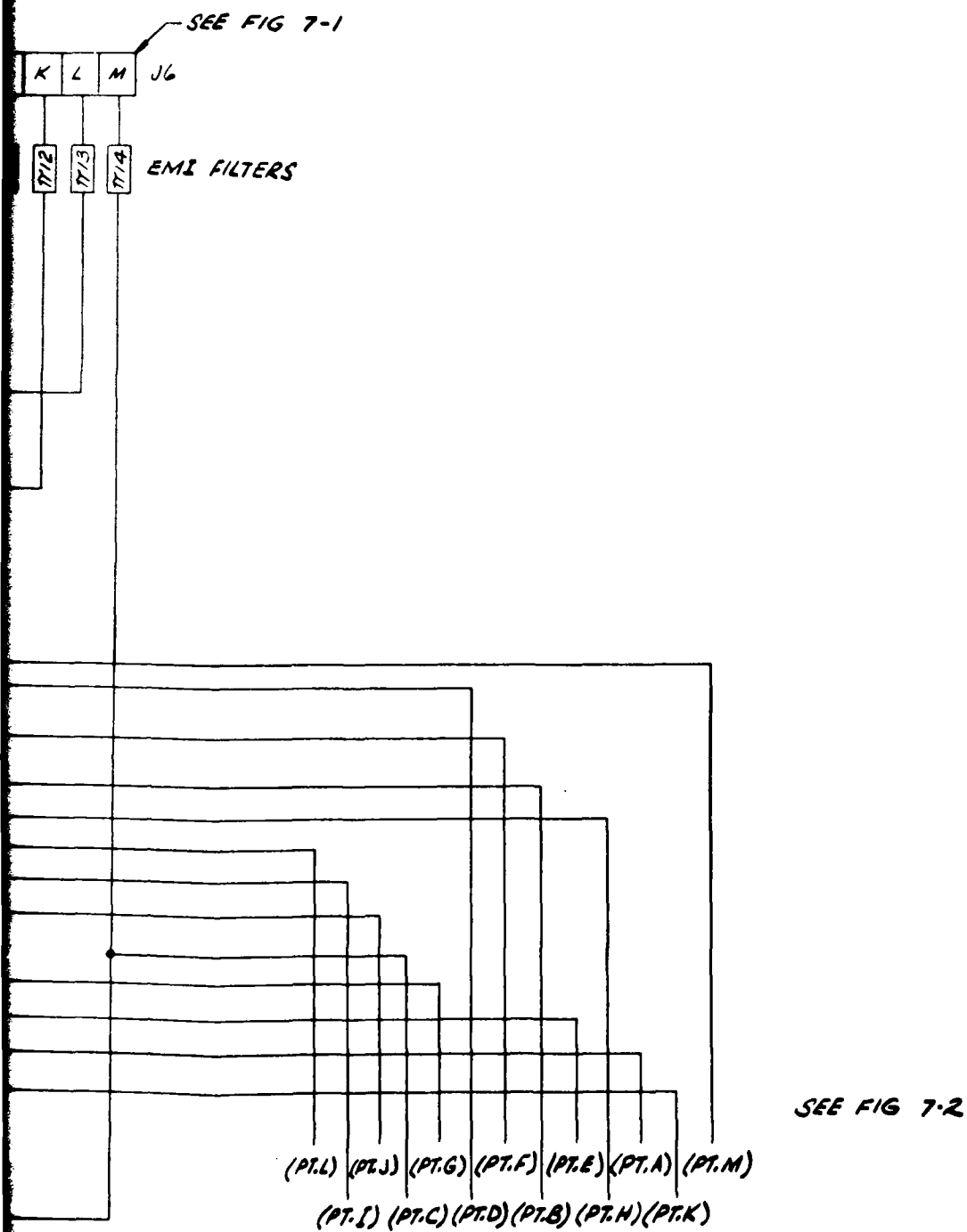
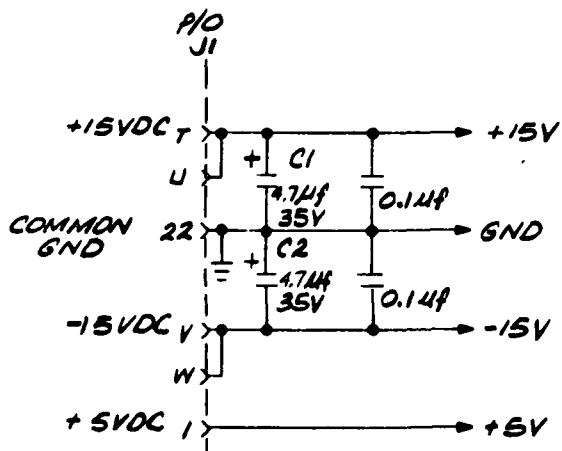
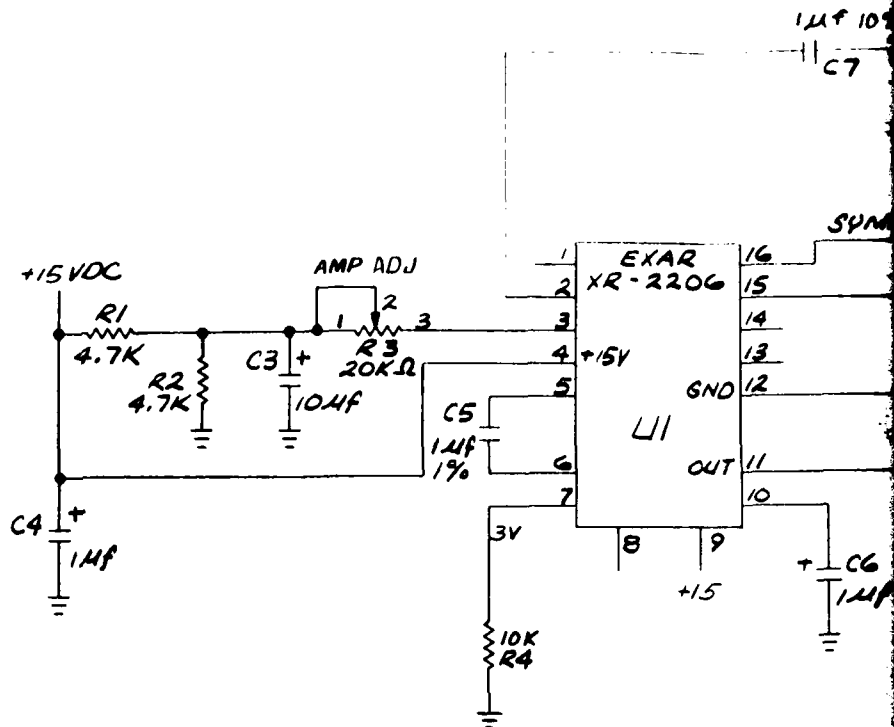
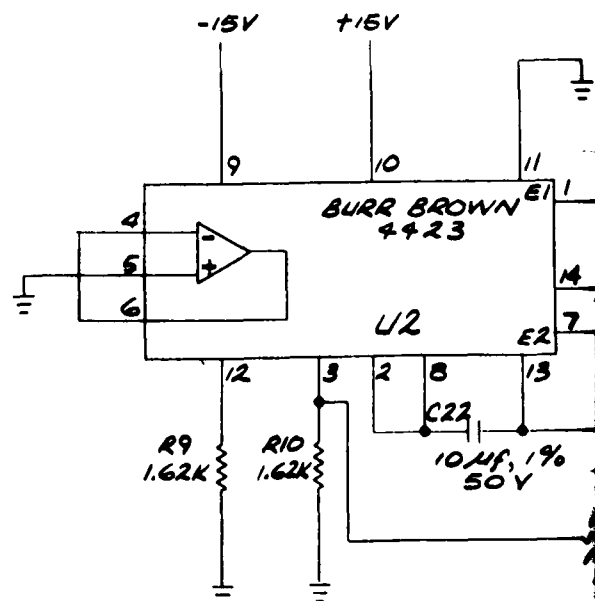


Figure E-5. MILES Transducer Interface Interconnection Diagram



NOTES:

1. Δ = SELECT VALUES DURING CALIBRATION OF MAGNETIC FIELD INTENSITY.



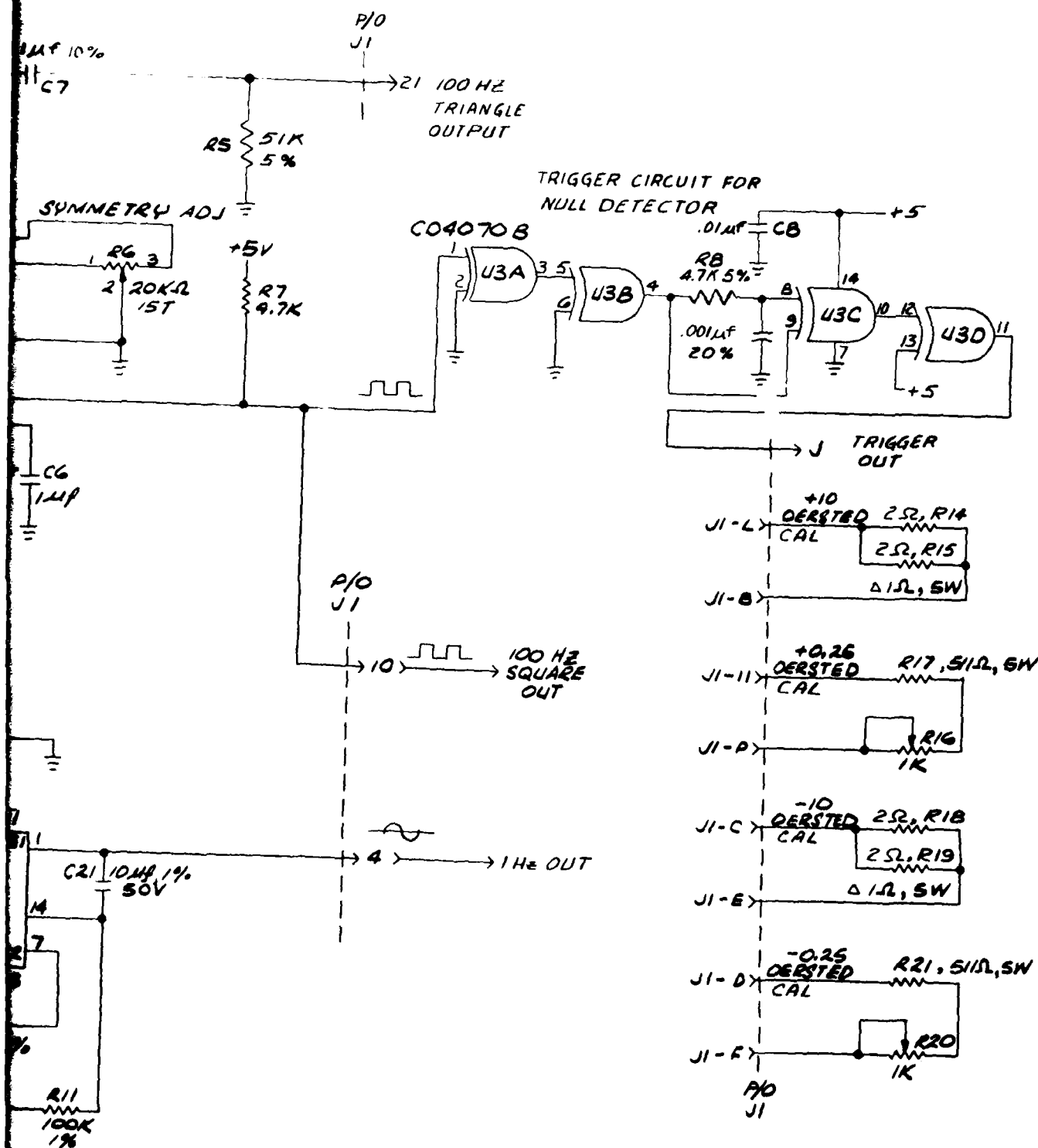
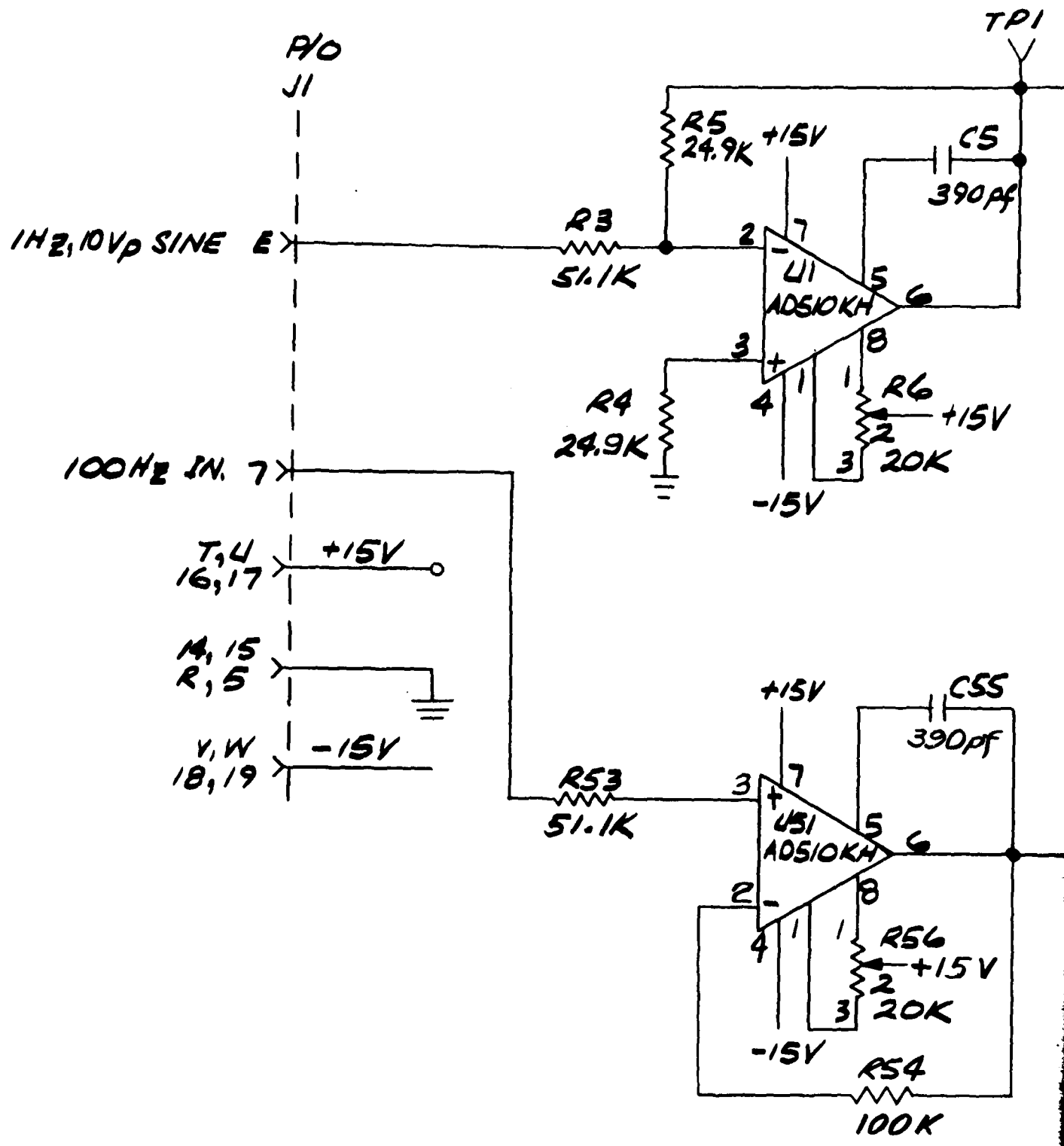


Figure E-6. Oscillators, A2 Board Schematic



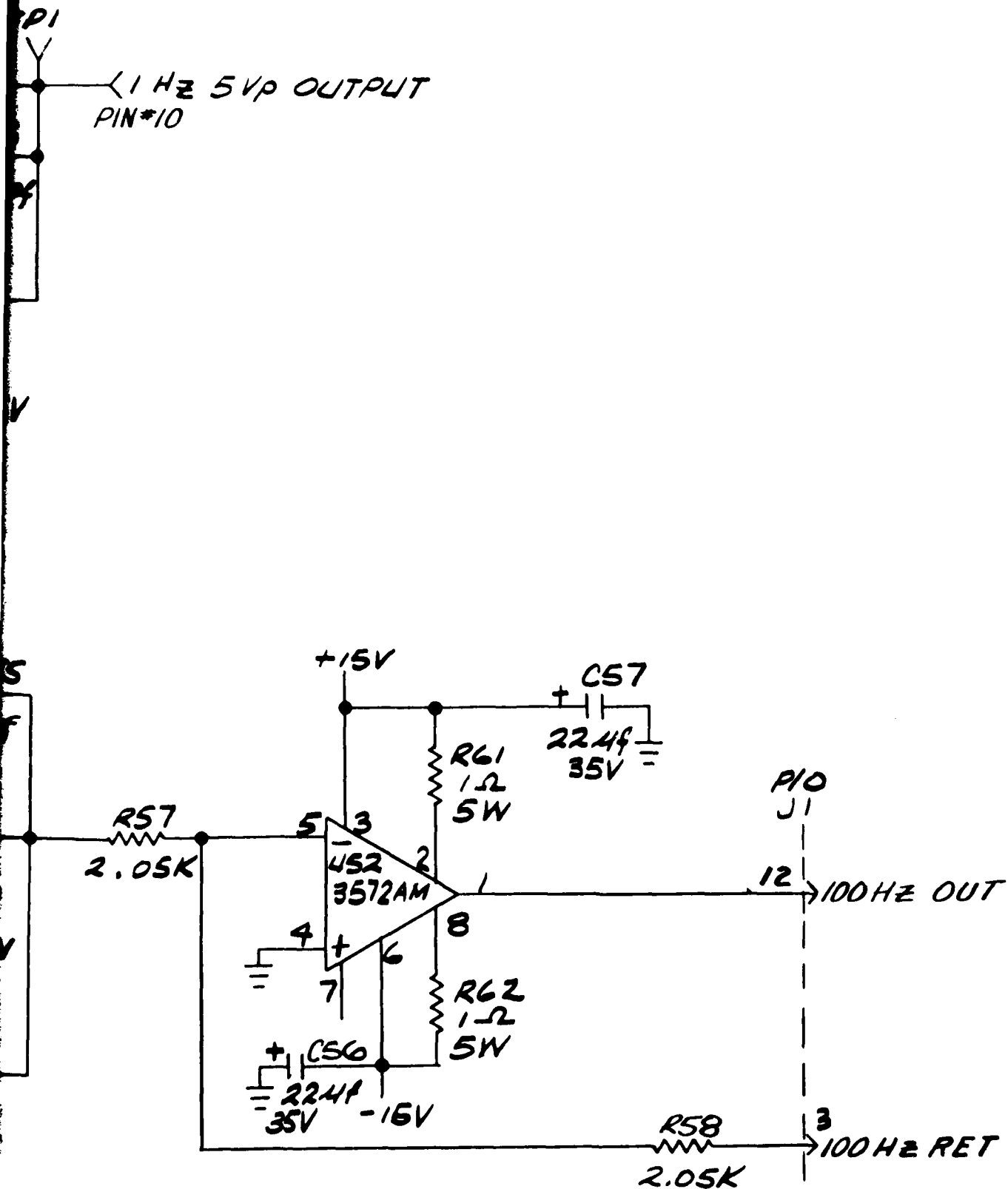
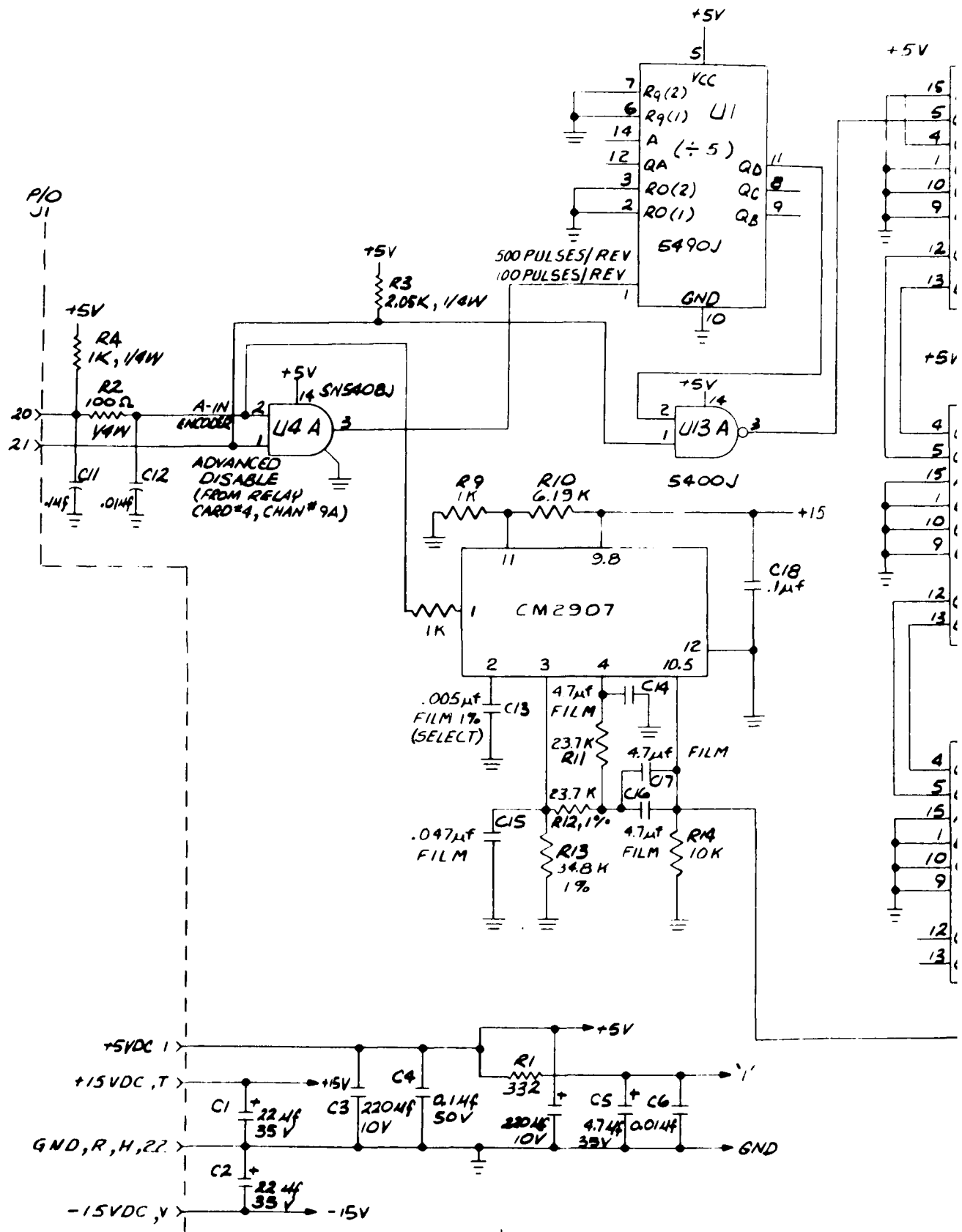


Figure E-7. Coil Drivers
A1 Board Schematic



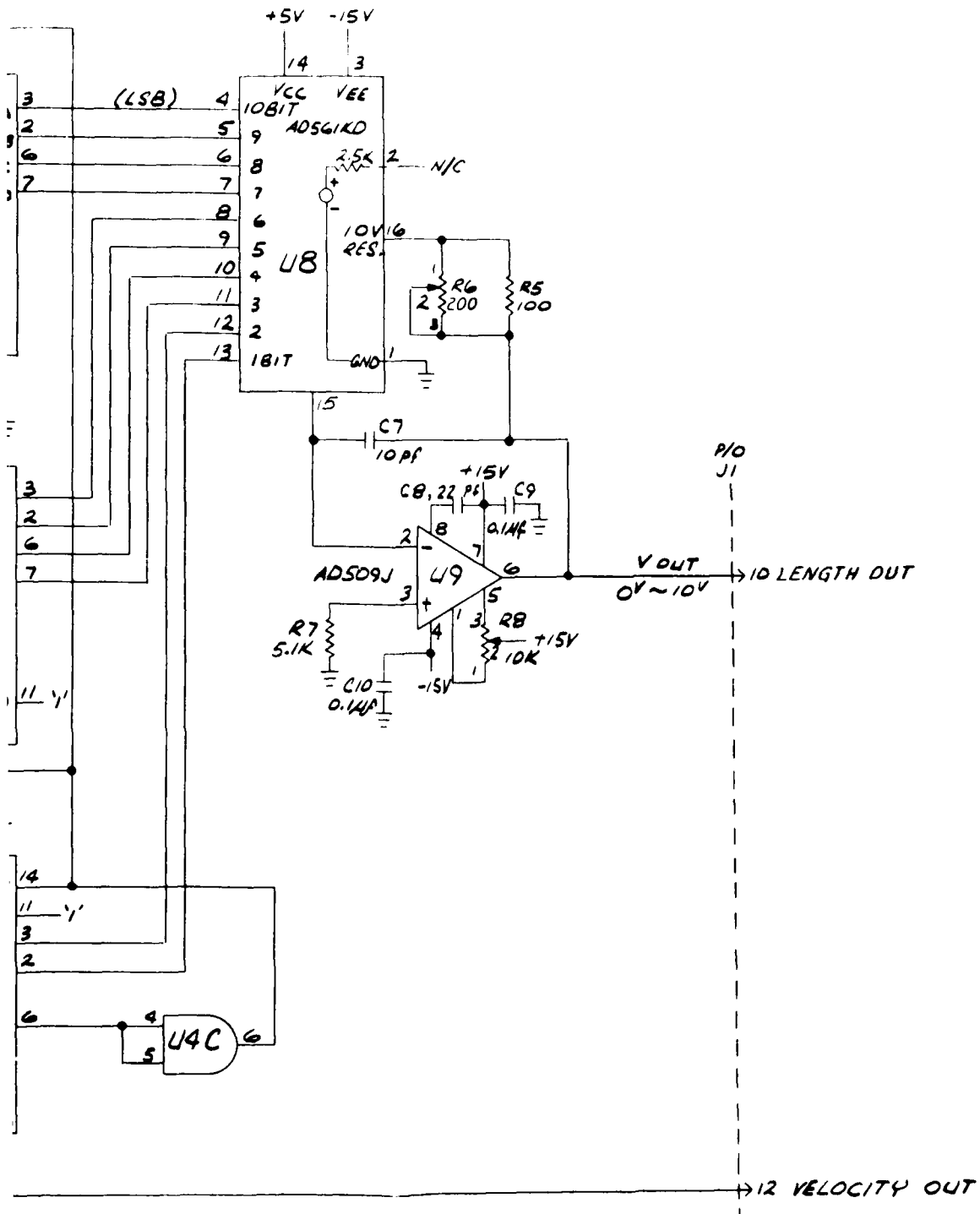


Figure E-8. Length Measurement
A4 Board

AD-A092 200

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F/G 15/3

MILES PRESSURE/SEISMIC RESPONSE ENGINEERING DEVELOPMENT OF MILE--ETC(U)

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F30602-76-C-0385

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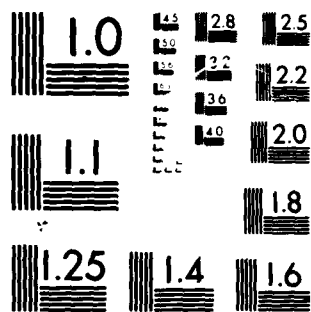
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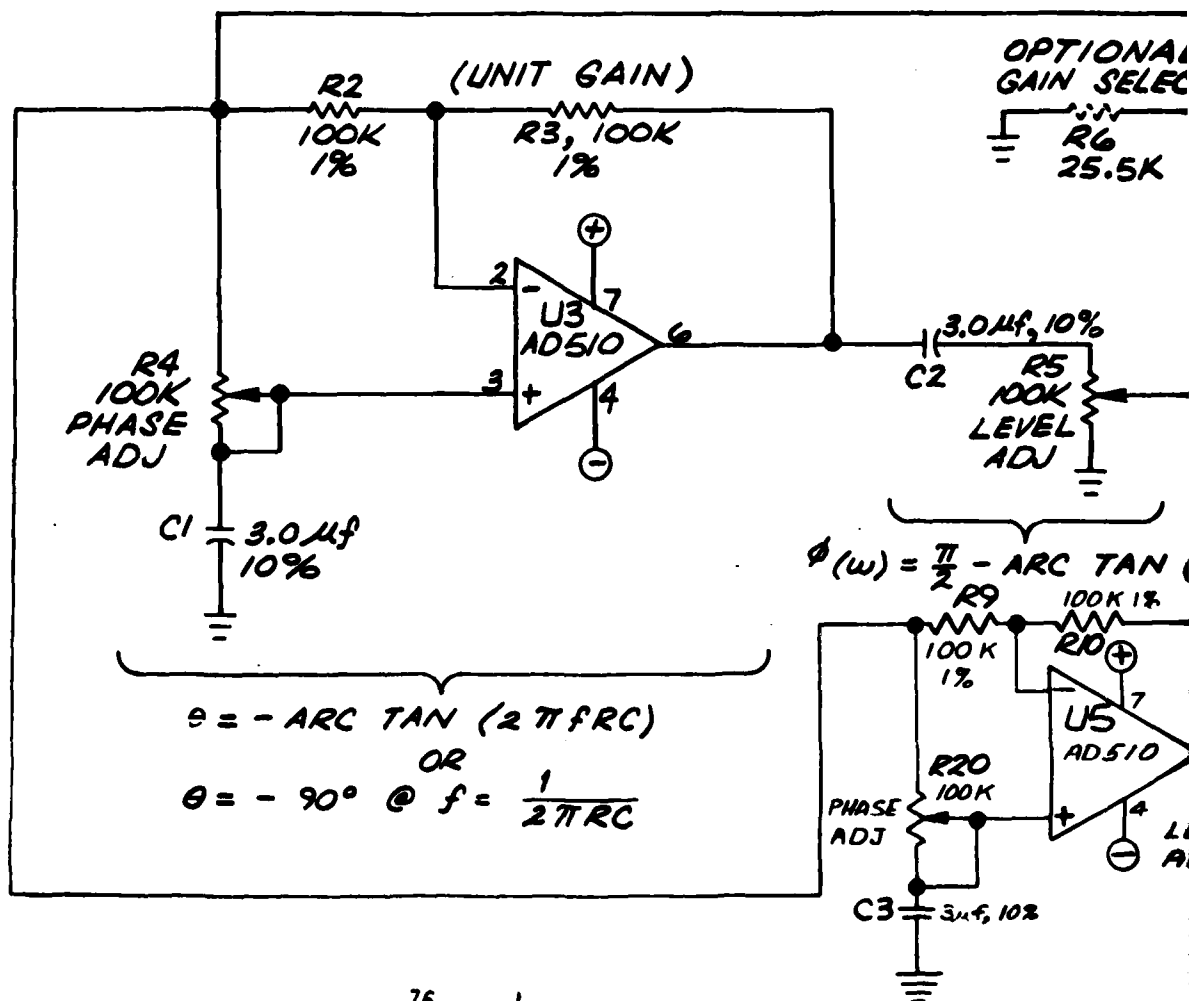
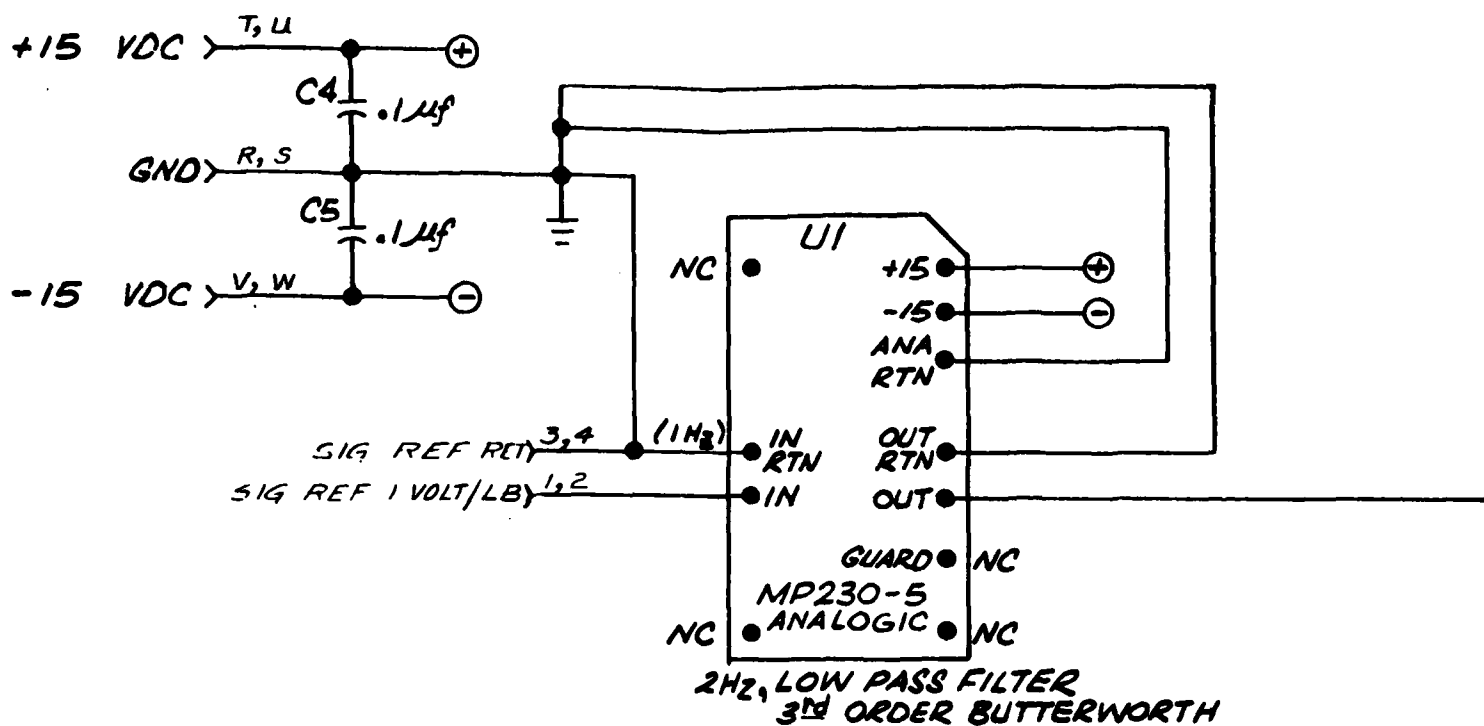
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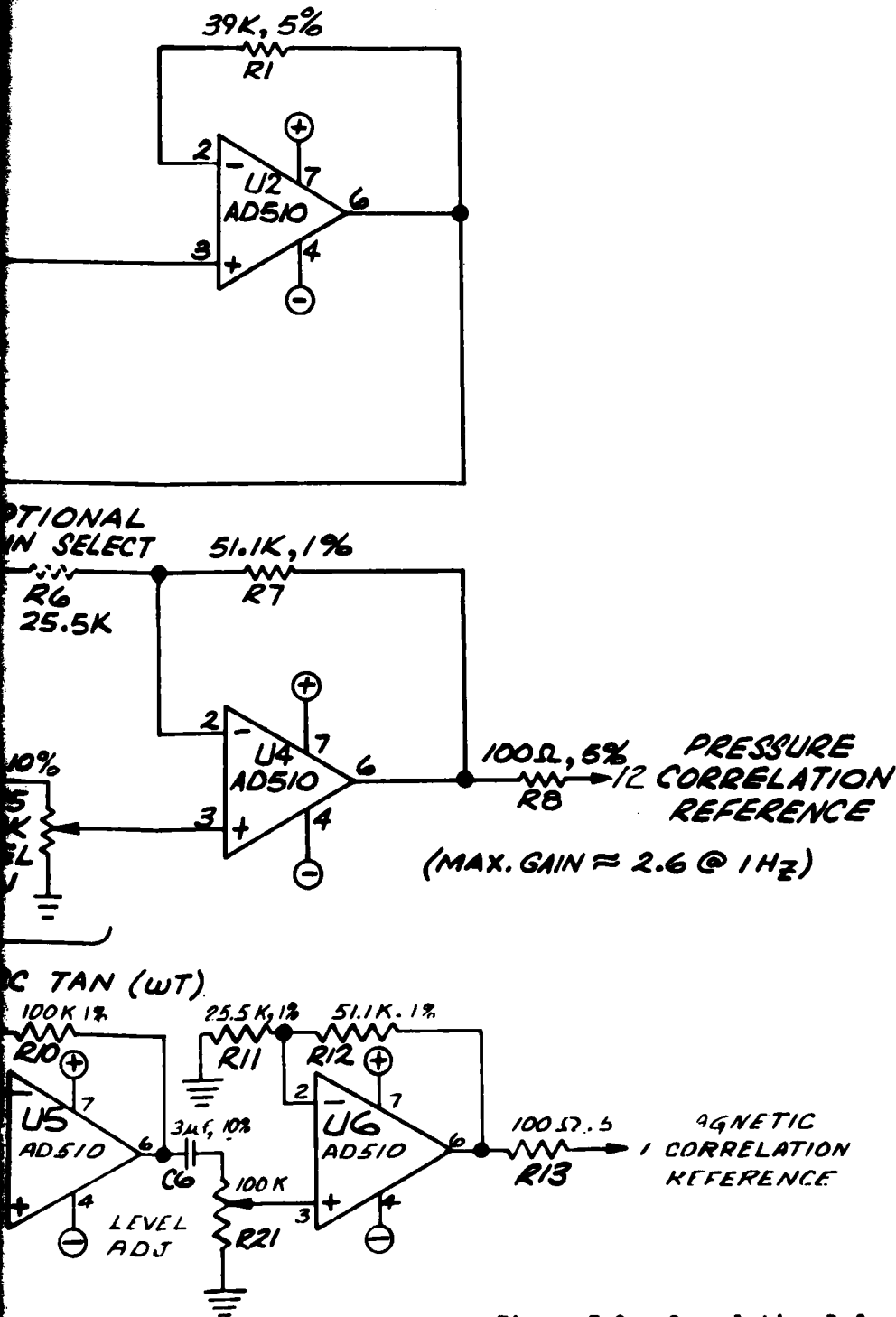
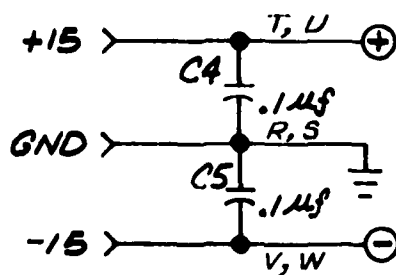
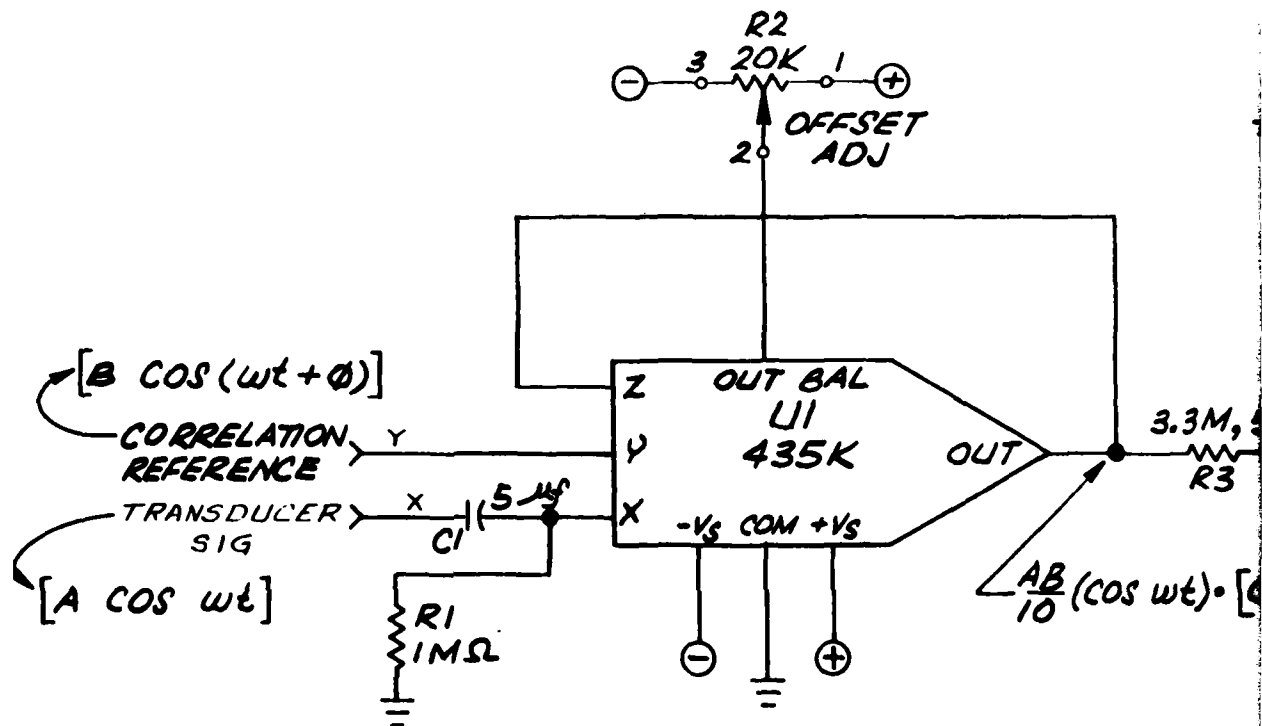


Figure E-9. Correlation Reference Circuit
A10 Board Schematic



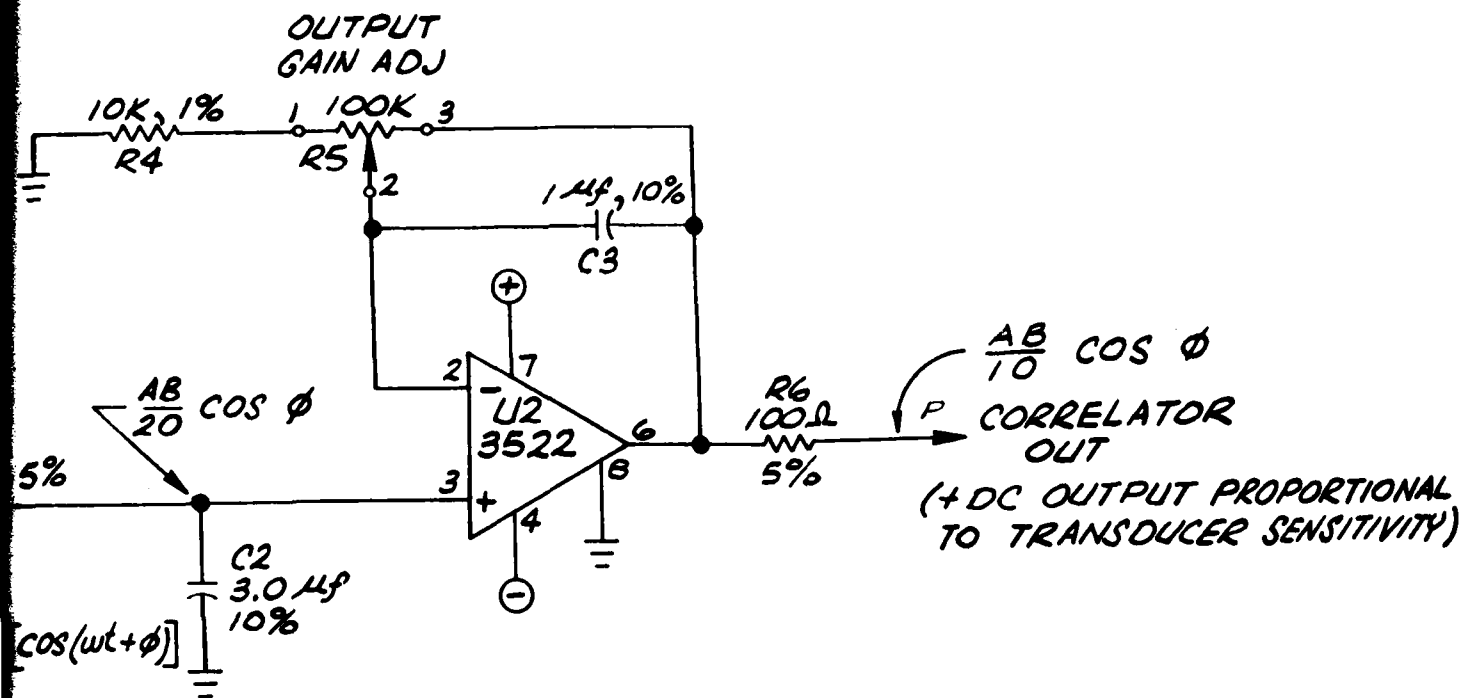


Figure E-10. Correlator
A9 Board Schematic

2

ATTACHMENT 1

MILES PRESSURE/SEISMIC RESPONSE

PHASE III

ACCEPTANCE TEST PLAN/PROCEDURES

S/N #001

TABLE OF CONTENTS

1.0 SCOPE

2.0 APPLICABLE DOCUMENTS

3.0 SYSTEM CALIBRATION

4.0 TEST PROCEDURES

5.0 QUALITY ASSURANCE PROVISIONS

Appendix I CALIBRATION DATA SHEETS

Appendix II TEST DATA SHEETS

1.0 SCOPE

1.1 Scope

This test plan establishes calibration procedures, quality inspections and test procedures, and performance requirements for factory acceptance of Transducer Test Set TS-3753/U&(). Test set performance will be verified on a standard transducer, Motional Pickup TR-299/G().

2.0 APPLICABLE DOCUMENTS

2.1 Government Documents

The following documents of the exact issue shown, form a part of this test plan to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this test plan, the contents of this test plan shall be considered a superseding requirement.

- Specification

MIL-T-38531 Amendment 3	Transducer, Motional Pickup TR 299/G()
----------------------------	---

- Standards

- Military

MIL-STD-130D Change B	Identification Marking of U.S. Military Property.
--------------------------	---

MIL-STD-143B	Standards and Specifications, Order of Precedence for the Selection of.
--------------	---

MIL-STD-454E	Standard General Requirements for Electronic Equipment.
--------------	---

MIL-STD-810C	Environmental Test Methods.
--------------	-----------------------------

MIL-STD-1472B	Human Engineering Design Criteria for Military Systems, Equipment and Facilities.
---------------	---

- Other Publications

AFSC	Design Handbook DH1-X. Checklist of general design criteria.
------	--

PR #A-6-1353 Amendment 4	Statement of Work, MILES Pressure/Seismic Response.
-----------------------------	---

S.O.W. CDRL Sequence #B003	MILES Pressure/Seismic Response, Operating Hazard Analysis, Phase II.
-------------------------------	---

S.O.W. CDRL MILES Pressure/Seismic Response, Test Plan/
Sequence #B004 Procedures, Phase II.

S.O.W. CDRL MILES Pressure/Seismic Response, Acceptance Test
Sequence #B005 Report, Phase II.

S.O.W. CDRL MILES Pressure/Seismic Response, Commercial
Sequence #C002 Maintenance Manual.

3.0 SYSTEM CALIBRATION

3.1 Test Device Set Up

Locate the test device in a lab area. Do not take special precaution to shield the test device from normal lab electrical and seismic noise. Reasonable caution shall be taken to insure that the test device is not located where the transducer conditioning and loading apparatus may be inadvertently bumped or exposed to magnetic materials in close proximity. Locate the test device electronics rack in a position where the operator has a clear view of the transducer conditioning and loading apparatus. Connect all interface cables.

3.2 Calibration Test Equipment

Laboratory test equipment of the exact model number or equivalent specified on the calibration equipment data sheet shall be used. Record the lab equipment calibration dates.

3.3 Test Device Calibration

Calibrate the test device to within the specifications listed on the test device calibration data sheets. Record the calibration values. Refer to the test set maintenance manual for additional information on system calibration.

4.0 TEST PROCEDURES

4.1 Standard Test Transducer

The tests called out in this section shall be run on Transducer, Motional Pickup TR-299/G(), Serial No. 001. The test procedures are called out on the test data sheets.

4.2 Automated Data Acquisition and Sequence Control Operation

4.2.1 Manual Sequencing, Manual Test Point Selection

- a. Software
- b. Sequence Control Smoothness
- c. Test Time
- d. Rewind Time

- e. Positioning Accuracy
- f. Display Clarity
- g. Data Clarity
- h. Transducer Damage Inspection

4.2.2 Manual Sequencing, Automatic Test Point Selection

- a. Software
- b. Sequence Control Smoothness
- c. Test Time
- d. Rewind Time
- e. Positioning Accuracy
- f. Display Clarity
- g. Data Clarity
- h. Transducer Damage Inspection

4.2.3 Automatic Sequencing, Manual Test Point Selection

- a. Software
- b. Sequence Control Smoothness
- c. Test Time
- d. Rewind Time
- e. Positioning Accuracy
- f. Display Clarity
- g. Data Clarity
- h. Transducer Damage Inspection

4.2.4 Automatic Sequencing, Automatic Test Point Selection

- a. Software
- b. Sequence Control Smoothness
- c. Test Time
- d. Rewind Time
- e. Positioning Accuracy
- f. Display Clarity
- g. Data Clarity
- h. Transducer Damage Inspection
- i. Limit Switch
- j. Failure Mode

4.3 Measurement Accuracy

Run ten automatic tests on standard transducer.

4.3.1 DCR (Direct Current Resistance), IR (Insulation Resistance)

- a. Measured Accuracy

4.3.2 Mechanical Response

- a. Repeatability

4.3.3 Magnetic Response

- a. Repeatability

4.3.4 Distance Between Transpositions

- a. Measured Accuracy

5.0 QUALITY ASSURANCE INSPECTION PROCEDURES

5.1 Quality Assurance Personnel

Honeywell designated quality control personnel shall perform the quality assurance inspections called out in this section. The quality assurance data sheets are in Appendix II.

5.2 Nameplates and Product Marking

Identification and marking shall be in accordance with the provisions of MIL-STD-130. Indicate conformance on the quality assurance data sheet.

5.3 Workmanship

All workmanship shall be in accordance with the Honeywell Sea, Air and Ground Workmanship Standard UED 23036. Indicate conformance on the quality assurance data sheet.

5.4 Test Set Performance Verification

Quality personnel shall verify the accuracy of the performance data collected in 4.0 and sign off on each data sheet.

APPENDIX I

CALIBRATION DATA SHEETS

Transducer Test Set TS-3553/U

Calibration Equipment Data Sheet

Serial Number 001

Date 3-24-80

Sheet 1 of 7

TEST EQUIPMENT LIST	CALIBRATION DATE
Storage Oscilloscope 466 Tektronics	1/17/80
Fluke Model 8040A DMM Bell	2/13/80
Gauss Meter Model 640	1/16/80

Quality Assurance: _____

Date _____

Transducer Test Set TS-3753/U+()

Calibration Data Sheet

Serial Number 001

Date 3-24-80

Sheet 2 of 7

PRECALIBRATION CHECK LIST	TECHNICIAN SIGN OFF
1. Plug in power cord from console	<i>DMB</i>
2. Mount the supply reel with the "standard MILES transducer" on the supply-rewind axle, with the connector end of the UUT* facing the test chamber from the top of the reel. * Unit Under Test	<i>DMB</i>
3. Ensure that the end of the UUT is secure, so it will stay in place as the reel is turned. Align the level winder by turning the reel manually until the level winder guide is in line with the end of the UUT.	<i>DMB</i>
4. Press the end plate against the reel and tighten the allen screw that holds it in place. Secure the locking screw into the reel.	<i>DMB</i>
5. Adjust the brake on each stand so that the drag is just enough to stop the reels from freewheeling.	<i>DMB</i>
6. Release the end of the UUT, and pass it through the level winder guide and through each of the cable clamps and the null coil.	<i>DMB</i>
7. Align the level winder guide on the takeup-advance assembly to guide the UUT directly to the connector or the reel.	<i>DMB</i>
8. Connect P8 on the UUT to J8 on the reel.	<i>DMB</i>
9. Turn the takeup reel until the marker arrow points up and the UUT makes less than one complete turn on the reel.	<i>DMB</i>
10. Connect the male 1/4" quick connect coupling from the test set pneumatic system to 85±5 PSI shop air.	<i>DMB</i>
11. Adjust the pneumatic regulator. Set the high pressure regulator to 60 PSI and the low pressure regulator to 31 PSI.	<i>DMB</i>
12. Set the following console instruments ON-OFF switches to ON: Scanner Voltmeter(SVM) Motor Speed Control Multimeter(DMM) D-to-A Converter Computer	<i>DMB</i>

Quality Assurance: _____

Date _____


Transducer Test Set TS-3753/U+()

Calibration Data Sheet

Serial Number 001

Date 3-24-80

Sheet 3 of 7

PRECALIBRATION CHECK LIST	TECHNICIAN SIGN OFF
13. Set the DMM function to $K\Omega$ and range to AUTO.	

Quality Assurance: _____

Date _____ 88

Transducer Test Set TS-3753/U+()

Calibration Data Sheet

Serial Number 001

Date 3-24-80

Sheet 4 of 7

CALIBRATION CHECK LIST	TECHNICIAN SIGN OFF
1. Turn on preamp power (switch on bottom front panel of cabinet) and main power (switch on upper right of cabinet). Wait five minutes before proceeding.	<i>DMB</i>
2. Coil Drivers, Circuit Board A1 a. Short terminal 7 to terminal 15. b. Short terminal 12 to terminal 3. c. Attach positive lead from digital voltmeter to terminal 12. Attach negative lead to terminal 15. Set meter to dc volts and AUTO range. d. Adjust R56 until meter reads 0.000 ± 0.005 volt. e. Remove shorts made in steps a and b. f. Remove meter connections.	<i>DMB</i>
3. Length Measurement Circuit, Circuit Board A4 a. Attach positive lead from digital voltmeter to terminal 10. Attach negative lead to terminal 22. b. Slowly rotate wheel of shaft encoder on length measurer until voltmeter reading is minimum. c. Adjust R8 until meter reads 0.000 ± 0.005 volt. d. Slowly rotate wheel of shaft encoder until voltmeter reading is maximum. e. Adjust R6 until meter reads 10.0 ± 0.005 volts. f. Remove meter connection.	<i>DMB</i>
4. Insert Function Test Cartridge into computer.	<i>DMB</i>
5. Preamp Offset, MILES Transducer Interface Assembly a. Allow a minimum of 2 hours after turning on the preamp power supply for warmup before proceeding with this test. b. Load calibration program (Function Test Cartridge, file 1) by inputting the following sequence via the keyboard: LOAD 1 EXECUTE c. Press RUN and follow the programmed instructions. Record the specified data. 1) Programmed instructions: a) TERMINATE PREAMP INPUT. Terminate preamp input, terminate A and B of J7, with a 260 ± 5 ohm $\frac{1}{4}$ watt metal film resistor.	<i>DMB</i>

Quality Assurance: _____

Date _____ 89

Transducer Test Set TS-3753/U+()

Calibration Data Sheet

Serial Number 001

Date 3-24-80

Sheet 5 of 7

CALIBRATION CHECK LIST	TECHNICIAN SIGN OFF																
<p>b) ALLOW PREAMP TO WARM UP FOR 2 HR. See step 5a.</p> <p>c) ADJUST R30 UNTIL BEEP, THEN STOP. This adjusts the preamp offset to less than .02 volts.</p> <p>d) VOLTMETER READING = ? The value of the offset voltage is displayed continually until the offset is less than 0.02 volts. Then the value of the offset voltage is printed out.</p> <p>e) GAIN CHECK. The next steps provide for measuring the preamplifier gain.</p> <p>f. ATTACH SCOPE PB TO OSC BD TER #4. ATTACH GROUND LEAD TO #22. Attach oscilloscope probe to terminal 4 of circuit board A2. Ground oscilloscope to terminal 22.</p> <p>g) ATTACH OTHER PROBE TIP TO JB1 #5. Attach the other oscilloscope probe to terminal TB1-5 in junction box JB1.</p> <p>h) REMOVE PREAMP TERMINATION. Remove 260 ohm preamp termination.</p> <p>i) FROM TERMINAL #4 OSC BOARD INPUT P-P SCOPE READING, app 20 V. Input value of the peak-peak voltage seen at terminal 4 of circuit board A2. Attach jumper from this terminal to TB-1 in JB1.</p> <p>j) FROM JB1 #5 INPUT VOLTAGE P-P, 10 V. Input value of the peak-peak voltage seen at terminal TB1-5 in junction box JB1. Remove jumper.</p> <p>k) PREAMP TEST COMPLETE. The preamplifier gain will be printed out; first in decibels then in absolute numbers.</p> <p>2) Record the printed data.</p> <table border="1"> <thead> <tr> <th></th> <th>MIN</th> <th>MAX</th> <th>TEST</th> </tr> </thead> <tbody> <tr> <td>Offset(V)</td> <td>---</td> <td>.02</td> <td><u>0.01</u></td> </tr> <tr> <td>Gain(db)</td> <td>103</td> <td>109</td> <td><u>106.3</u></td> </tr> <tr> <td>Gain</td> <td></td> <td></td> <td><u>20.105</u></td> </tr> </tbody> </table> <p>d. Remove the oscilloscope probes.</p> <p>6. Earth Field Bias, Circuit Board A2.</p> <p>a. Load auto test program (Auto Test Cartridge, file 0) by inputting the following sequence via the keyboard:</p> <p style="text-align: center;">LOAD 0 EXECUTE</p>		MIN	MAX	TEST	Offset(V)	---	.02	<u>0.01</u>	Gain(db)	103	109	<u>106.3</u>	Gain			<u>20.105</u>	<p style="text-align: center;">#1</p> <p style="text-align: center;">V O M P</p> <p style="text-align: center;">J</p> <p style="text-align: center;">D S M B</p>
	MIN	MAX	TEST														
Offset(V)	---	.02	<u>0.01</u>														
Gain(db)	103	109	<u>106.3</u>														
Gain			<u>20.105</u>														

Quality Assurance: _____

Date _____ 90

Transducer Test Set TS-3753/U+()

Calibration Data Sheet

Serial Number 001

Date 3-24-80

Sheet 6 of 7

CALIBRATION CHECK LIST	TECHNICIAN SIGN OFF
<p>b. Initiate auto test program. Input: RUN</p> <p>c. Choose manual test point selection and auto sequencing.</p> <p>d. Continue program until computer displays: READY FOR MAGNETIC TEST</p> <p>e. Wait approximately 5 seconds; then press STOP.</p> <p>f. Adjust RNC2 in JB4 to 15KΩ.</p> <p>g. Using a gauss meter such as the Bell 640 Incremental Gauss Meter, adjust R16 so that the gauss meter reads 0.25 gauss with the probe oriented in the same direction as the transducer at the center of field bias coil 1.</p> <p>h. Measure R16 and adjust R20 to the same value.</p> <p>i. Adjust RNC2 in JB4 to 17400Ω-0.5 R16.</p> <p>j. Repeat steps 6.g. through 6.i. until RNC2 and the magnetic field strength are both correct.</p> <p>7. Correlation Reference Circuits, Circuit Board A10.</p> <p>a. Load auto test program (Auto Test Cartridge, file 0) by inputting the following sequence via the keyboard:</p> <p style="text-align: center;">LOAD 0 EXECUTE</p> <p>b. Initiate auto test program. Input: RUN</p> <p>c. Choose auto sequencing.</p> <p>d. Continue program until computer displays: READY FOR P/S DATA</p> <p>e. Wait approximately 5 seconds; then press STOP.</p> <p>f. Measure force transducer output (VAF) at JB3 between TB2-5 and TB2-6.</p> <p>g. Disconnect lead from terminal TB1-5 in junction box JB-1.</p> <p>h. Short terminals X and R on circuit board A9.</p> <p>i. Adjust R2 on circuit board A9 until SVM reads 0.00±0.01 volt.</p> <p>j. Remove short between terminals X and R and place short between terminals X and Y.</p> <p>k. Attach oscilloscope probe to terminal Y. Ground oscilloscope to terminal R of circuit board A9.</p> <p>l. Record peak-to-peak voltage, V, of signal displayed on oscilloscope (approximately 10 volts).</p> <p>m. Adjust R5 on circuit board A9 until SVM reads (V/2)²/10. For example, if V=10, adjust R5 until meter reads 2.5 volts.</p>	<p style="text-align: center;">↓</p> <p style="text-align: right;">DMB</p>

Quality Assurance: _____

Date _____ 91

APPENDIX II

TEST DATA SHEETS

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 001

Date 3-24-80

Sheet 1 of 14

Para. 4.2.1 MANUAL SEQUENCING MANUAL TEST POINT SELECTION	TECHNICIAN SIGN OFF
1. Insert Automatic Test Cartridge into the computer and load the automatic test program by inputting the following sequence via the keyboard: LOAD 0 EXECUTE	DMD
2. Press RUN and follow the programmed instructions.	DMD
3. Choose manual sequencing and manual test point selection. The test points selected shall be 3, 4, 50 and 82.	DMD
4. Perform the following test. When the test requires data to be recorded, record the data in the technician sign-off column; if a qualitative judgement is required, such as for smoothness of operation, assess the equipment performance and sign if adequate. Explain any deficiencies. a. Software. Does the program operate correctly? Check accuracy of mean and standard deviation calculations. b. Sequence Control Smoothness. Is the transducer transport operation smooth? Check for 'jerky' transducer movement, especially when starting or stopping. c. Test Time. Record the test time at each transposition tested. $t_i \leq 4$ minutes Record the time required to move the transducer from 3 to 4. $t_m \leq 1$ minute d. Rewind Time. Record the rewind time. $t_{rew} \leq 4$ minutes e. Positioning Accuracy. Record the transposition numbers tested. Record the distance from the center of the transposition to the center line of center clamp for each test location.	<p> $\bar{x} = \frac{12.5 + 14.8 + 12.2}{3} = 13.4$ $s = 1.1$ $\sigma_s = 1.1$ </p> <p> $t_3 = 3.04$ $t_4 = 3.03$ $t_{50} = 3.03$ $t_{82} = 3.04$ $t_{move} = 30 \text{ sec}$ $t_{rew} = 3.22$ $t_1 = 3$ $t_2 = 4$ $t_3 = 5.0$ $t_4 = 82$ </p> <p>DMD</p>

Quality Assurance: _____

Date _____ 94

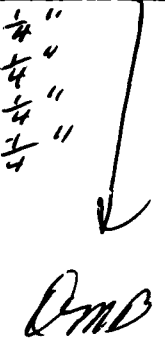
Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 001

Date 3-24-80

Sheet 2 of 14

Para. 4.2.1 MANUAL SEQUENCE MANUAL TEST POINT SELECTION	TECHNICIAN SIGN OFF
<p> $t_1 = 3$ $t_2 = 4$ $t_3 = 50$ $t_4 = 82$ $d \leq \frac{1}{2}$ inch f. Display Clarity. Assess the quality of the display. Is it readable? g. Data Clarity. Assess the quality of the data printout. Is it readable? h. Inspect the MILES transducer for damages caused by the test. </p>	<p> $d_1 = \frac{1}{4}"$ $d_2 = \frac{1}{4}"$ $d_3 = \frac{1}{4}"$ $d_4 = \frac{1}{4}"$  </p>

Quality Assurance: _____

Date _____ 95

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 001

Date 3-24-80

Sheet 3 of 14

Para. 4.2.2 MANUAL SEQUENCING AUTOMATIC TEST POINT SELECTION	TECHNICIAN SIGN OFF
1. Insert Automatic Test Cartridge into the computer and load the automatic test program by inputting the following sequence via the keyboard: LOAD 0 EXECUTE	<i>DGMB</i>
2. Press RUN and follow the programmed instructions.	<i>DGMB</i>
3. Choose manual sequencing and automatic test point selection. The test points selected shall be 10, 40, 60 and 80.	<i>DGMB</i>
4. Perform the following test. When the test requires data to be recorded, record the data in the technician sign-off column; if a qualitative judgement is required, such as for smoothness of operation, assess the equipment performance and sign if adequate. Explain any deficiencies. a. Software. Does the program operate correctly? Check accuracy of mean and standard deviation calculations. b. Sequence Control Smoothness. Is the transducer transport operation smooth? Check for "jerky" transducer movement, especially when starting or stopping. c. Test Time. Record the test time at each transposition tested. $t_i \leq 4$ minutes d. Rewind Time. Record the rewind time. $t_{rew} \leq 4$ minutes e. Positioning Accuracy. Record the transposition numbers tested. Record the distance from the center of the transposition to the centerline of the center and clamp for each test location. $t_1 = 10$ $t_2 = 40$ $t_3 = 60$ $t_4 = 80$ $d \leq \frac{1}{2}$ inch	$t_{10} = 3.04$ $t_{40} = 3.04$ $t_{60} = 3.04$ $t_{80} = 3.04$ $t_{rew} = 3.17$ $t_1 = 10$ $t_2 = 40$ $t_3 = 60$ $t_4 = 80$ $d_1 = \frac{1}{4}"$ $d_2 = \frac{1}{4}"$ $d_3 = \frac{1}{4}"$ $d_4 = \frac{1}{4}"$

Quality Assurance: _____

Date _____ 96


Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 001

Date 3-24-82

Sheet 4 of 14

Para. 4.2.2 MANUAL SEQUENCING AUTOMATIC TEST POINT SELECTION	TECHNICIAN SIGN OFF
<p>f. Display Clarity. Assess the quality of the display. Is it readable?</p> <p>g. Data Clarity. Assess the quality of the data printout. Is it readable?</p> <p>h. Inspect the MILES transducer for damage caused by the test.</p>	

Quality Assurance: _____

Date _____ 97


Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 001

Date 3-24-80

Sheet 5 of 14

Para. 4.2.3 AUTOMATIC SEQUENCING MANUAL TEST POINT SELECTION	TECHNICIAN SIGN OFF
1. Insert Automatic Test Cartridge into the computer and load the automatic test program by inputting the following sequence via the keyboard: LOAD 0 EXECUTE	<i>DMD</i>
2. Press RUN and follow the programmed instructions.	<i>DMD</i>
3. Choose automatic sequencing and manual test point selection. The test points selected shall be 3, 4, 50 and 82.	<i>DMD</i>
4. Perform the following test. When the test requires data to be recorded, record the data in the technician sign-off column; if a qualitative judgment is required, such as for smoothness of operation, assess the equipment performance and sign if adequate. Explain any deficiencies. a. Software. Does the program operate correctly? Check accuracy of mean and standard deviation calculations. b. Sequence Control Smoothness. Is the transducer transport operation smooth? Check for "jerky" transducer movement, especially when starting or stopping. c. Test Time. Record the test time at each transposition tested. $t_i \leq 4$ minutes Record the time required to move the transducer from 3 to 4. $t_m \leq 1$ minute d. Rewind time. Record the rewind time. $t_{rew} \leq 4$ minutes e. Positioning Accuracy. Record the transposition numbers tested. Record the distance from the center of the transposition to the centerline of the center clamp for each test location.	<div style="text-align: center;">  </div> $t_3 = 3.03$ $t_4 = 3.04$ $t_{50} = 3.04$ $t_{82} = 3.03$ $t_{move} = 30 \text{ sec}$ $t_{rew} = 3:21$ $t_1 = 3$ $t_2 = 4$ $t_3 = 5.0$ $t_4 = 8.2$ $d_1 = \frac{1}{3}$ $d_2 = \frac{1}{2}$

Quality Assurance: _____

Date _____ 98

Date _____ 99


Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 001

Date 3-24-80

Sheet 7 of 14

Para. 4.2.4 AUTOMATIC SEQUENCING AUTOMATIC TEST POINT SELECTION	TECHNICIAN SIGN OFF
1. Insert Automatic Test Cartridge into the computer and load the automatic test program by inputting the following sequence via the keyboard: LOAD 0 EXECUTE	<i>DMD</i>
2. Press RUN and follow the programmed instructions.	<i>DMD</i>
3. Choose automatic sequencing and automatic test point selection. The test points selected shall be 10, 40, 60 and 80.	<i>DMD</i>
4. Perform the following test. When the test requires data to be recorded, record the data in the technician sign-off column; if a qualitative judgment is required, such as for smoothness of operation, assess the equipment performance and sign if adequate. Explain any deficiencies. a. Software. Does the program operate correctly? Check accuracy of mean and standard deviation calculations. b. Sequence Control Smoothness. Is the transducer transport operation smooth. Check for "jerky" transducer movement, especially when starting or stopping. c. Test Time. Record the test time at each transposition tested. $t_i \leq 4$ minutes d. Rewind Time. Record the rewind time. $t_{rew} \leq 4$ minutes e. Positioning Accuracy. Record the transposition numbers tested. Record the distance from the center of the transposition to the centerline of the center clamp for each test location. $t_1 = 10$ $t_2 = 40$ $t_3 = 60$ $t_4 = 80$ $d \leq \frac{1}{2}$ inch	 <i>DMD</i> $t_{10} = 3:04$ $t_{40} = 3:04$ $t_{60} = 3:04$ $t_{80} = 3:04$ $t_{rew} = 3:17$ $t_1 = 10$ $t_2 = 40$ $t_3 = 60$ $t_4 = 80$ $d_1 = \frac{1}{4}$ $d_2 = \frac{1}{4}$ $d_3 = \frac{1}{4}$ $d_4 = \frac{1}{4}$

Quality Assurance: _____

Date _____ 100


Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 001

Date 3-24-80

Sheet 8 of 14

Para. 4.2.4 AUTOMATIC SEQUENCING AUTOMATIC TEST POINT SELECTION	TECHNICIAN SIGN OFF
<p>f. Display Clarity. Assess the quality of the display. Is it readable?</p> <p>g. Data Clarity. Assess the quality of the data printout. Is it readable?</p> <p>h. Inspect the MILES transducer for damages caused by the test.</p> <p>i. Limit Switch. Wrap a minimum of 10 transpositions around the takeup reel prior to restarting the automatic test sequence. Check for proper limit switch operation.</p> <p>j. Failure Mode. Disconnect the 1 Hz motor to cause a failure during P/S testing. Run another test. Choose automatic sequencing and automatic test point selection. After first transposition is tested, reconnect motor lead. Check the failure mode software and print out.</p>	

Quality Assurance: _____

Date _____ 101



Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 001

Date 3-27-80

Sheet 9 of 14

Para. 4.3 MEASUREMENT ACCURACY	TECHNICIAN SIGN OFF
1. Insert Automatic Test Cartridge into the computer and load the function test program by inputting the following sequence via the keyboard: LOAD 0 EXECUTE	
2. Press RUN and follow the programmed instructions.	
3. Choose automatic sequencing.	
4. Measure the cable DCR and IR at the end of the test. Record the measured DCR and IR on the test printout.	
5. Repeat steps 2 through 4 until a total of 5 tests have been run.	
	

Quality Assurance: _____


Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 001

Date 3-24-80

Sheet 10 of 14

Para. 4.3.1 DCR, IR	TECHNICIAN SIGN OFF																																										
<p>1. Record the measured and tested values of the DCR and IR from the Para. 4.3 test printouts.</p> <table border="1"> <thead> <tr> <th colspan="3">DCR</th> <th colspan="3">IR</th> </tr> <tr> <th>Measured</th> <th>Tested</th> <th>Error</th> <th>Measured</th> <th>Tested</th> <th>Error</th> </tr> </thead> <tbody> <tr> <td>252.9</td> <td>252.0</td> <td>0.4%</td> <td>252.9</td> <td>252.0</td> <td>0.4%</td> </tr> <tr> <td>253.0</td> <td>252.0</td> <td>0.4%</td> <td>"</td> <td>"</td> <td>"</td> </tr> <tr> <td>252.7</td> <td>252.0</td> <td>0.4%</td> <td>"</td> <td>"</td> <td>"</td> </tr> <tr> <td>252.9</td> <td>252.0</td> <td>0.4%</td> <td>"</td> <td>"</td> <td>"</td> </tr> <tr> <td>252.9</td> <td>252.0</td> <td>0.4%</td> <td>"</td> <td>"</td> <td>"</td> </tr> </tbody> </table> <p>The difference between the tested and measured values shall not exceed $\pm 1\%$ of the measured value. This requirement does not apply to the IR reading if they exceed the range of the test instrument.</p>	DCR			IR			Measured	Tested	Error	Measured	Tested	Error	252.9	252.0	0.4%	252.9	252.0	0.4%	253.0	252.0	0.4%	"	"	"	252.7	252.0	0.4%	"	"	"	252.9	252.0	0.4%	"	"	"	252.9	252.0	0.4%	"	"	"	
DCR			IR																																								
Measured	Tested	Error	Measured	Tested	Error																																						
252.9	252.0	0.4%	252.9	252.0	0.4%																																						
253.0	252.0	0.4%	"	"	"																																						
252.7	252.0	0.4%	"	"	"																																						
252.9	252.0	0.4%	"	"	"																																						
252.9	252.0	0.4%	"	"	"																																						

Quality Assurance: _____

Date _____ 103

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number

001

Date



3-24-80

Sheet

11

of

14

Para. 4.3.2 MECHANICAL RESPONSE	TECHNICIAN SIGN OFF																		
<p>1. Record the values of the P/S means from the printouts obtained in the Para. 4.3 tests. Calculate the mean and standard deviation of these values.</p> $\mu_p = \sum_{i=1}^5 \frac{e_i}{5}$ $\sigma_p^2 = \sum_{i=1}^5 \frac{(e_i - \mu_p)^2}{5 - 1}$ $\sigma_p \leq 0.1 \mu_p$ $\leq 0.1 \times 12.3 = 1.23$ <table> <tr> <td>12.1 - 12.3</td> <td>= -0.2</td> <td>.04</td> </tr> <tr> <td>12.4 - 12.3</td> <td>= .1</td> <td>.01</td> </tr> <tr> <td>12.3 - 12.3</td> <td>= 0</td> <td>0</td> </tr> <tr> <td>12.2 - 12.3</td> <td>= -.1</td> <td>.01</td> </tr> <tr> <td>12.3 - 12.3</td> <td>= 0</td> <td>0</td> </tr> <tr> <td></td> <td></td> <td><u>.06</u></td> </tr> </table>	12.1 - 12.3	= -0.2	.04	12.4 - 12.3	= .1	.01	12.3 - 12.3	= 0	0	12.2 - 12.3	= -.1	.01	12.3 - 12.3	= 0	0			<u>.06</u>	<p> $e_1 = 12.1$ $e_2 = 12.4$ $e_3 = 12.3$ $e_4 = 12.2$ $e_5 = 12.3$ </p> <p> $\mu_p = 12.3$ $\sigma_p = 0.24$ 0.12 </p> <p>   </p>
12.1 - 12.3	= -0.2	.04																	
12.4 - 12.3	= .1	.01																	
12.3 - 12.3	= 0	0																	
12.2 - 12.3	= -.1	.01																	
12.3 - 12.3	= 0	0																	
		<u>.06</u>																	

Quality Assurance:

Date

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number

001

Date

3-24-80

Sheet

12

of

14

Para. 4.3.3 MAGNETIC RESPONSE	TECHNICIAN SIGN OFF
<p>1. Record the values of magnetic means from the print outs obtained in the Para. 4.3 tests. Calculate the mean and standard deviation of these values.</p> $\mu_m = \sum_{i=1}^5 \frac{e_i}{5}$ $\sigma_m^2 = \sum_{i=1}^5 \frac{(e_i - \mu_m)^2}{5 - 1}$ $\sigma_m \leq 0.1 \mu_m$ $\leq 0.1 \times .19 = .019$	<p> $e_1 = .19$ $e_2 = .19$ $e_3 = .19$ $e_4 = .19$ $e_5 = .19$ </p> <p> $\mu_m = .19$ $\sigma_m = 0$ </p> <p><i>[Signature]</i></p>

Quality Assurance: _____

Date

105

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number

001

Date



3-24-80

Sheet

13

of

14

Para. 4.3.4 DISTANCE BETWEEN TRANSPOSITIONS	TECHNICIAN SIGN OFF												
1. Modify the function test program to print out all the distance between transposition measurements.													
2. Run a complete test using the modified program.													
<p>3. Make actual measurements of the distance between transpositions at the specified locations. The measurement shall be made from the center line of the first transposition to the center line of the second transposition.</p> <table border="1"> <thead> <tr> <th></th> <th>Tested Value</th> <th>Measured Value</th> </tr> </thead> <tbody> <tr> <td>$d_3 = T_3 - T_4$</td> <td>43.2</td> <td>43</td> </tr> <tr> <td>$d_{10} = T_{10} - T_{11}$</td> <td>43.0</td> <td>43</td> </tr> <tr> <td>$d_{75} = T_{75} - T_{76}$</td> <td>43.0</td> <td>43</td> </tr> </tbody> </table> <p>The tested value and the measured value must agree within $\pm 1\%$ of the measured value.</p>		Tested Value	Measured Value	$d_3 = T_3 - T_4$	43.2	43	$d_{10} = T_{10} - T_{11}$	43.0	43	$d_{75} = T_{75} - T_{76}$	43.0	43	
	Tested Value	Measured Value											
$d_3 = T_3 - T_4$	43.2	43											
$d_{10} = T_{10} - T_{11}$	43.0	43											
$d_{75} = T_{75} - T_{76}$	43.0	43											
4. Calculate the mean and standard deviation (see para. 4.3.2 tests) of the distance between transposition measurements. The results must agree with the printout results.													
<p>Print Out</p> <p>$\mu_d = 43.1$</p> <p>$\sigma_d = 0.2$</p>	 												

Quality Assurance: _____

Date _____ 106

Transducer Test Set TS-3753/U+()

Quality Data Sheet

Serial Number 001

Date 3-26-80

Sheet 14 of 14

Para. 5.2 NAMEPLATES AND PRODUCT MARKING	TECHNICIAN SIGN OFF
<p>1. Indicate conformance with MIL-STD-130.</p> <p>Quality Assurance: <u><i>R. Marting</i></u></p> <p>Date: <u>3-26-80</u></p>	
<p>Para. 5.3 WORKMANSHIP</p> <p>1. Indicate conformance with the Honeywell Sea, Air and Ground Workmanship Standard UED 23036.</p> <p>Quality Assurance: <u><i>R. Marting</i></u></p> <p>Date: <u>3-26-80</u></p>	

Quality Assurance: _____

Date _____ 107

MILES TRANSDUCER
AUTOMATIC TEST

8 24 80

SERIAL #001

DC = 254 0
IR = 19000000 0

CABLE TRANS.# 3
PRESSURE SENS.
13.5 00 16
MAGNETIC SENS.
0.19 00 90mm0

CABLE TRANS.# 4
PRESSURE SENS.
-14.8 00 16
MAGNETIC SENS.
-0.19 00 90mm0

CABLE TRANS.#50
PRESSURE SENS.
-12.6 00 16
MAGNETIC SENS.
-0.19 00 90mm0

CABLE TRANS.#82
PRESSURE SENS.
-12.6 00 16
MAGNETIC SENS.
-0.19 00 90mm0

FINAL POSITION
DC = 254 0
IR = 19000000 0

P S DATA RESULTS
ps= 13.400/16
ms= 1.100/16

MAG DATA RESULTS
md= 0.18000/90mm0
mm= 0.00000/90mm0

LENGTH RESULTS
md= 43.1inches
md= 0.2inches

TRANSPPOSITIONS
TOTAL= 86.00

** TRANSDUCER **
*** PASSED ***

Unit #001 Manual Sequencing,
Manual Test Point Selection
Paragraph 4.2.1

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #001

:::::::::::::
OCR = 256 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-12.3 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#40
PRESSURE SENS.
-13.1 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#60
PRESSURE SENS.
-11.2 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.6 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

FINAL POSITION
OCR = 253 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 12.3 $\mu\text{V/lb}$
 σs = 0.8 $\mu\text{V/lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V/gamma}$
 σm = 0.00 $\mu\text{V/gamma}$

LENGTH RESULTS
 μd = 43.1 inches
 σd = 0.2 inches

TRANSPOSITIONS
TOTAL = 86.00

TRANSDUCER ##
PASSED ###
#####

Unit #001 Manual Sequencing,
Automatic Test Point Selection
Paragraph 4.2.2

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #001

.....
DCR = 254 Ω
IR = 19000000 Ω

CABLE TRANS.# 3
PRESSURE SENS.
13.8 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.# 4
PRESSURE SENS.
-14.9 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#50
PRESSURE SENS.
-12.7 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#82
PRESSURE SENS.
-12.4 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

FINAL POSITION
DCR = 254 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 13.4 $\mu\text{V/lb}$
 σs = 1.2 $\mu\text{V/lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V/gamma}$
 σm = 0.00 $\mu\text{V/gamma}$

LENGTH RESULTS
 μd = 43.1inches
 σd = 0.2inches

TRANSPPOSITIONS
TOTAL= 86.00

TRANSDUCER ##
PASSED ###
#####

Unit #001 Automatic Sequencing,
Manual Test Point Selection
Paragraph 4.2.3

MILES TRANSDUCER
AUTOMATIC TEST

3-24-80

SERIAL #001

.....
OCR = 254 Q
IR = 19000000 Q

CABLE TRANS.#10
PRESSURE SENS.
-12.3 uv/lb
MAGNETIC SENS.
-0.19 uv/gamma

CABLE TRANS.#40
PRESSURE SENS.
-12.6 uv/lb
MAGNETIC SENS.
-0.19 uv/gamma

CABLE TRANS.#60
PRESSURE SENS.
-11.2 uv/lb
MAGNETIC SENS.
-0.19 uv/gamma

CABLE TRANS.#80
PRESSURE SENS.
-12.9 uv/lb
MAGNETIC SENS.
-0.19 uv/gamma

FINAL POSITION
OCR = 254 Q
IP = 19000000 Q

P/S DATA RESULTS
us= 12.2uv/lb
os= 0.8uv/lb

MAG DATA RESULTS
um= 0.19uv/gamma
om= 0.00uv/gamma

LENGTH RESULTS
ud= 43.1inches
od= 0.2inches

TRANSPPOSITIONS
TOTAL= 86.00

\$\$ TRANSDUCER \$\$
\$\$\$ PASSED \$\$\$

Unit #001 Automatic Sequencing,
Automatic Test Point Selection
Paragraph 4.2.4

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #001

:::::::::::::
DCR = 254 Ω
IR = 19000000 Ω

CABLE TRANS.#10
BAD P/S SEN.!!
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{g}$

CABLE TRANS.#40
PRESSURE SENS.
-12.7 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{g}$

CABLE TRANS.#60
PRESSURE SENS.
-11.0 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{g}$

CABLE TRANS.#80
PRESSURE SENS.
-12.9 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{g}$

FINAL POSITION
DCR = 254 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μ_s = 9.2 $\mu\text{V}/\text{lb}$
 σ_s = 6.1 $\mu\text{V}/\text{lb}$

MAG DATA RESULTS
 μ_m = 0.19 $\mu\text{V}/\text{g}$
 σ_m = 0.00 $\mu\text{V}/\text{g}$

LENGTH RESULTS
 μ_d = 43.1 inches
 σ_d = 0.2 inches

TRANSPPOSITIONS
TOTAL= 86.00

TRANSDUCER ##
FAILED ####
#####

TOTAL DEFECTS
3.00

DEFECT LIST

BAD P/S AT TRP
10.00
BAD P/S MEAN
HIGH P/S STD DV

Unit #001 Automatic Sequencing,
Automatic Test Point Selection, Failure Mode
Paragraph 4.2.4.J

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #001/4.3/

:::::::::::::
DCR = 254 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-12.2 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{gmma}$

CABLE TRANS.#40
PRESSURE SENS.
-12.8 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{gmma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.8 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{gmma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.5 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{gmma}$

FINAL POSITION
DCR = 254 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 12.1 $\mu\text{V}/\text{lb}$
 σs = 0.9 $\mu\text{V}/\text{lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V}/\text{gmma}$
 σm = 0.00 $\mu\text{V}/\text{gmma}$

LENGTH RESULTS
 μd = 43.1 inches
 σd = 0.2 inches

TRANSPPOSITIONS
TOTAL = 86.00

TRANSDUCER ##
PASSED ###
#####

DCR 252.9 Ω
IR > 18.848 $\text{M}\Omega$

Unit #001 Measurement Accuracy
Paragraph 4.3 Run #1

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #1/4.3/2

:::::::::::::
DCR = 254 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-12.8 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#40
PRESSURE SENS.
-13.1 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.9 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.8 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

FINAL POSITION
DCR = 253 Ω
IR = 19000000 Ω

F/S DATA RESULTS
 $\mu\text{s} = 12.4\mu\text{V/lb}$
 $\sigma\text{s} = 1.0\mu\text{V/lb}$

MAG DATA RESULTS
 $\mu\text{m} = 0.19\mu\text{V/gamma}$
 $\sigma\text{m} = 0.00\mu\text{V/gamma}$

LENGTH RESULTS
 $\mu\text{d} = 43.1\text{inches}$
 $\sigma\text{d} = 0.2\text{inches}$

TRANSPPOSITIONS
TOTAL= 86.00

TRANSDUCER ##
PASSED ###
#####

DCR 253.0 Ω
IR 718.888m Ω

Unit #001 Measurement Accuracy
Paragraph 4.3 Run #2

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #1/42/3

:::::::::::::
DCR = 254 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-12.4 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#40
PRESSURE SENS.
-12.9 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#60
PRESSURE SENS.
-11.0 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.7 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

FINAL POSITION
DCR = 253 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 12.3 $\mu\text{V/lb}$
 σs = 0.9 $\mu\text{V/lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V/gamma}$
 σm = 0.00 $\mu\text{V/gamma}$

LENGTH RESULTS
 μd = 43.1 inches
 σd = 0.2 inches

TRANSPPOSITIONS
TOTAL = 86.00

\$\$ TRANSDUCER \$\$
\$\$\$\$ PASSED \$\$\$\$
#####

DCR 252.9 Ω
IR > 18.888 M Ω

Unit #001 Measurement Accuracy
Paragraph 4.3 Run #3

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #1/4.3/4

:::::::::::::
DCR = 254 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-12.5 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{gmma}$

CABLE TRANS.#40
PRESSURE SENS.
-13.1 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{gmma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.8 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{gmma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.5 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V}/\text{gmma}$

FINAL POSITION
DCR = 254 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 12.2 $\mu\text{V}/\text{lb}$
 σs = 1.0 $\mu\text{V}/\text{lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V}/\text{gmma}$
 σm = 0.00 $\mu\text{V}/\text{gmma}$

LENGTH RESULTS
 μd = 43.1 inches
 σd = 0.2 inches

TRANSPPOSITIONS
TOTAL = 86.00

TRANSDUCER ##
PASSED ###
#####

DCR 252.9 Ω
IR > 18.888 M Ω

Unit #001 Measurement Accuracy
Paragraph 4.3 Run #4

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #1/4.3/5

:::::::::::
DCR = 254 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-12.6 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#40
PRESSURE SENS.
-13.2 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.9 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.5 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

FINAL POSITION
DCR = 254 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 12.3 $\mu\text{V/lb}$
 σs = 1.0 $\mu\text{V/lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V/gamma}$
 σm = 0.00 $\mu\text{V/gamma}$

LENGTH RESULTS
 μd = 43.1 inches
 σd = 0.2 inches

TRANSPOSITIONS
TOTAL = 86.00

\$\$ TRANSDUCER \$\$
\$\$\$ PASSED \$\$\$

DCR 252.9 Ω
IR > 18.888M Ω

Unit #001 Measurement Accuracy
Paragraph 4.3 Run #5

MILES TRANSDUCER
FUNCTIONAL TEST

P/S mean 15.00
P/S mean L 5.00
P/S sd L 10.00
MAG mean 0.20
MAG mean L 0.05
MAG sd L 0.10
Tn Dt mean 43.00
Tn mean L 1.00
Tn sd L 2.00

3/24/80

SERIAL #1/4.3.4

:::::::::::::
DCR = 253 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-12.6 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#40
PRESSURE SENS.
-13.0 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.6 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.6 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

FINAL POSITION
DCR = 254 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 12.2 $\mu\text{V/lb}$
 σs = 1.1 $\mu\text{V/lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V/gamma}$
 σm = 0.00 $\mu\text{V/gamma}$

LENGTH RESULTS
 μd = 43.1 inches
 σd = 0.2 inches

TRANSPPOSITIONS
TOTAL = 86.00

\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$
\$\$ TRANSDUCER \$\$
\$\$\$\$ PASSED \$\$\$\$
\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$

Unit #001 Distance Between Transpositions
Functional Test (Sheet 1)
Paragraph 4.3.4

TRP# 1L= 43.2	TRP# 26L= 43.3
TRP# 2L= 43.2	TRP# 27L= 43.0
TRP# 3L= 43.1	TRP# 28L= 43.1
TRP# 4L= 43.1	TRP# 29L= 43.3
TRP# 5L= 43.1	TRP# 30L= 43.0
TRP# 6L= 43.2	TRP# 31L= 43.3
TRP# 7L= 42.8	TRP# 32L= 43.0
TRP# 8L= 43.3	TRP# 33L= 43.2
TRP# 9L= 43.0	TRP# 34L= 42.9
TRP# 10L= 43.0	TRP# 35L= 43.2
TRP# 11L= 43.3	TRP# 36L= 43.0
TRP# 12L= 43.1	TRP# 37L= 42.6
TRP# 13L= 43.2	TRP# 38L= 43.2
TRP# 14L= 43.2	TRP# 39L= 42.9
TRP# 15L= 43.1	TRP# 40L= 42.8
TRP# 16L= 43.1	TRP# 41L= 42.5
TRP# 17L= 43.1	TRP# 42L= 43.2
TRP# 18L= 43.2	TRP# 43L= 43.0
TRP# 19L= 43.2	TRP# 44L= 43.1
TRP# 20L= 43.1	TRP# 45L= 43.4
TRP# 21L= 43.2	TRP# 46L= 43.2
TRP# 22L= 43.1	TRP# 47L= 43.2
TRP# 23L= 43.0	TRP# 48L= 43.2
TRP# 24L= 43.2	TRP# 49L= 43.2
TRP# 25L= 43.2	TRP# 50L= 43.3

Unit #001 Distance Between Transpositions
 Functional Test (Sheet 2)
 Paragraph 4.3.4

TRP# 51L= 43.2

TRP# 52L= 43.1

TRP# 53L= 43.3

TRP# 54L= 43.0

TRP# 55L= 43.3

TRP# 56L= 43.1

TRP# 57L= 42.7

TRP# 58L= 43.2

TRP# 59L= 43.2

TRP# 60L= 43.4

TRP# 61L= 43.1

TRP# 62L= 43.2

TRP# 63L= 43.4

TRP# 64L= 43.2

TRP# 65L= 43.2

TRP# 66L= 43.0

TRP# 67L= 43.3

TRP# 68L= 43.2

TRP# 69L= 43.2

TRP# 70L= 43.3

TRP# 71L= 43.1

TRP# 72L= 43.2

TRP# 73L= 43.2

TRP# 74L= 43.2

TRP# 75L= 43.0

TRP# 76L= 43.1

TRP# 77L= 42.8

TRP# 78L= 43.2

TRP# 79L= 43.2

TRP# 80L= 43.2

TRP# 81L= 43.1

TRP# 82L= 43.3

TRP# 83L= 42.8

Unit #001 Distance Between Transpositions
Functional Test (Sheet 3)
Paragraph 4.3.4

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #001

.....
DCP = 253 Ω
IR = 19000000 Ω

Limit Switch
OK

MILES TRANSDUCER
AUTOMATIC TEST

Unit #001 Limit Switch Test
Paragraph 4.2.4.i

MILES TRANSDUCER
AUTOMATIC TEST

3/25/80

SERIAL #001

:::::::::::::
DCR = 254 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-12.9 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#40
PRESSURE SENS.
-12.5 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.18 $\mu\text{V/gamma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.5 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.7 $\mu\text{V/lb}$
MAGNETIC SENS.
-0.19 $\mu\text{V/gamma}$

FINAL POSITION
DCR = 254 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 12.2 $\mu\text{V/lb}$
 σs = 1.1 $\mu\text{V/lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V/gamma}$
 σm = 0.00 $\mu\text{V/gamma}$

LENGTH RESULTS
 μd = 43.1 inches
 σd = 0.2 inches

TRANSPOSITIONS
TOTAL = 86.00

\$\$ TRANSDUCER \$\$
\$\$\$ PASSED \$\$\$
#####

Unit #001 Witness Test

ATTACHMENT 2

MILES PRESSURE/SEISMIC RESPONSE

PHASE III

ACCEPTANCE TEST PLAN/PROCEDURES

S/N #002

TABLE OF CONTENTS

1.0 SCOPE

2.0 APPLICABLE DOCUMENTS

3.0 SYSTEM CALIBRATION

4.0 TEST PROCEDURES

5.0 QUALITY ASSURANCE PROVISIONS

Appendix I CALIBRATION DATA SHEETS

Appendix II TEST DATA SHEETS

1.0 SCOPE

1.1 Scope

This test plan establishes calibration procedures, quality inspections and test procedures, and performance requirements for factory acceptance of Transducer Test Set TS-3753/U&(). Test set performance will be verified on a standard transducer, Motional Pickup TR-299/G().

2.0 APPLICABLE DOCUMENTS

2.1 Government Documents

The following documents of the exact issue shown, form a part of this test plan to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this test plan, the contents of this test plan shall be considered a superseding requirement.

- Specification

MIL-T-38531 Amendment 3	Transducer, Motional Pickup TR 299/G()
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- Standards

- Military

MIL-STD-130D Change B	Identification Marking of U.S. Military Property.
MIL-STD-143B	Standards and Specifications, Order of Precedence for the Selection of.
MIL-STD-454E	Standard General Requirements for Electronic Equipment.
MIL-STD-810C	Environmental Test Methods.
MIL-STD-1472B	Human Engineering Design Criteria for Military Systems, Equipment and Facilities.

- Other Publications

AFSC	Design Handbook DH1-X. Checklist of general design criteria.
PR #A-6-1353 Amendment 4	Statement of Work, MILES Pressure/Seismic Response.
S.O.W. CDRL Sequence #B003	MILES Pressure/Seismic Response, Operating Hazard Analysis, Phase II.

S.O.W. CDRL MILES Pressure/Seismic Response, Test Plan/
Sequence #B004 Procedures, Phase II.

S.O.W. CDRL MILES Pressure/Seismic Response, Acceptance Test
Sequence #B005 Report, Phase II.

S.O.W. CDRL MILES Pressure/Seismic Response, Commercial
Sequence #C002 Maintenance Manual.

3.0 SYSTEM CALIBRATION

3.1 Test Device Set Up

Locate the test device in a lab area. Do not take special precaution to shield the test device from normal lab electrical and seismic noise. Reasonable caution shall be taken to insure that the test device is not located where the transducer conditioning and loading apparatus may be inadvertently bumped or exposed to magnetic materials in close proximity. Locate the test device electronics rack in a position where the operator has a clear view of the transducer conditioning and loading apparatus. Connect all interface cables.

3.2 Calibration Test Equipment

Laboratory test equipment of the exact model number or equivalent specified on the calibration equipment data sheet shall be used. Record the lab equipment calibration dates.

3.3 Test Device Calibration

Calibrate the test device to within the specifications listed on the test device calibration data sheets. Record the calibration values. Refer to the test set maintenance manual for additional information on system calibration.

4.0 TEST PROCEDURES

4.1 Standard Test Transducer

The tests called out in this section shall be run on Transducer, Motional Pickup TR-299/G(), Serial No. 002. The test procedures are called out on the test data sheets.

4.2 Automated Data Acquisition and Sequence Control Operation

4.2.1 Manual Sequencing, Manual Test Point Selection

- a. Software
- b. Sequence Control Smoothness
- c. Test Time
- d. Rewind Time

- e. Positioning Accuracy
- f. Display Clarity
- g. Data Clarity
- h. Transducer Damage Inspection

4.2.2 Manual Sequencing, Automatic Test Point Selection

- a. Software
- b. Sequence Control Smoothness
- c. Test Time
- d. Rewind Time
- e. Positioning Accuracy
- f. Display Clarity
- g. Data Clarity
- h. Transducer Damage Inspection

4.2.3 Automatic Sequencing, Manual Test Point Selection

- a. Software
- b. Sequence Control Smoothness
- c. Test Time
- d. Rewind Time
- e. Positioning Accuracy
- f. Display Clarity
- g. Data Clarity
- h. Transducer Damage Inspection

4.2.4 Automatic Sequencing, Automatic Test Point Selection

- a. Software
- b. Sequence Control Smoothness
- c. Test Time
- d. Rewind Time
- e. Positioning Accuracy
- f. Display Clarity
- g. Data Clarity
- h. Transducer Damage Inspection
- i. Limit Switch
- j. Failure Mode

4.3 Measurement Accuracy

Run five automatic tests on standard transducer.

4.3.1 DCR (Direct Current Resistance), IR (Insulation Resistance)

- a. Measured Accuracy

4.3.2 Mechanical Response

- a. Repeatability

4.3.3 Magnetic Response

- a. Repeatability

4.3.4 Distance Between Transpositions

a. Measured Accuracy

5.0 QUALITY ASSURANCE INSPECTION PROCEDURES

5.1 Quality Assurance Personnel

Honeywell designated quality control personnel shall perform the quality assurance inspections called out in this section. The quality assurance data sheets are in Appendix II.

5.2 Nameplates and Product Marking

Identification and marking shall be in accordance with the provisions of MIL-STD-130. Indicate conformance on the quality assurance data sheet.

5.3 Workmanship

All workmanship shall be in accordance with the Honeywell Sea, Air and Ground Workmanship Standard UED 23036. Indicate conformance on the quality assurance data sheet.

5.4 Test Set Performance Verification

Quality personnel shall verify the accuracy of the performance data collected in 4.0 and sign off on each data sheet.

APPENDIX I

CALIBRATION DATA SHEETS

Transducer Test Set TS-3553/U

Calibration Equipment Data Sheet

Serial Number 002

Date 3-24-80

Sheet 1 of 7

TEST EQUIPMENT LIST	CALIBRATION DATE
Storage Oscilloscope 466 Tektronics	1/17/80
Fluke Model 8040A DMM Bell	2/13/80
Gauss Meter Model 640	1/16/80

Quality Assurance: _____

Date _____

Transducer Test Set TS-3753/U+()

Calibration Data Sheet

Serial Number 002

Date 3-24-80

Sheet 2 of 7

PRECALIBRATION CHECK LIST	TECHNICIAN SIGN OFF
1. Plug in power cord from console	<i>DGMB</i>
2. Mount the supply reel with the "standard MILES transducer" on the supply-rewind axle, with the connector end of the UUT* facing the test chamber from the top of the reel. * Unit Under Test	<i>DGMB</i>
3. Ensure that the end of the UUT is secure, so it will stay in place as the reel is turned. Align the level winder by turning the reel manually until the level winder guide is in line with the end of the UUT.	<i>DGMB</i>
4. Press the end plate against the reel and tighten the allen screw that holds it in place. Secure the locking screw into the reel.	<i>DGMB</i>
5. Adjust the brake on each stand so that the drag is just enough to stop the reels from freewheeling.	<i>DGMB</i>
6. Release the end of the UUT, and pass it through the level winder guide and through each of the cable clamps and the null coil.	<i>DGMB</i>
7. Align the level winder guide on the takeup-advance assembly to guide the UUT directly to the connector or the reel.	<i>DGMB</i>
8. Connect P8 on the UUT to J8 on the reel.	<i>DGMB</i>
9. Turn the takeup reel until the marker arrow points up and the UUT makes less than one complete turn on the reel.	<i>DGMB</i>
10. Connect the male 1/2" quick connect coupling from the test set pneumatic system to 85±5 PSI shop air.	<i>DGMB</i>
11. Adjust the pneumatic regulator. Set the high pressure regulator to 60 PSI and the low pressure regulator to 31 PSI.	<i>DGMB</i>
12. Set the following console instruments ON-OFF switches to ON: Scanner Voltmeter(SVM) Motor Speed Control Multimeter(DMM) D-to-A Converter Computer	<i>DGMB</i>

Quality Assurance: _____

Date _____ 132

Transducer Test Set TS-3753/U+()

Calibration Data Sheet

Serial Number 002

Date 3-24-80

Sheet 3 of 7

PRECALIBRATION CHECK LIST	TECHNICIAN SIGN OFF
13. Set the DMM function to $K\Omega$ and range to AUTO.	<i>[Signature]</i>

Quality Assurance: _____

Date _____ 133

Transducer Test Set TS-3753/U+()

Calibration Data Sheet

Serial Number 002

Date 3-24-80

Sheet 4 of 7

CALIBRATION CHECK LIST	TECHNICIAN SIGN OFF
1. Turn on preamp power (switch on bottom front panel of cabinet) and main power (switch on upper right of cabinet). Wait five minutes before proceeding.	<i>DGMB</i>
2. Coil Drivers, Circuit Board A1 a. Short terminal 7 to terminal 15. b. Short terminal 12 to terminal 3. c. Attach positive lead from digital voltmeter to terminal 12. Attach negative lead to terminal 15. Set meter to dc volts and AUTO range. d. Adjust R56 until meter reads 0.000 ± 0.005 volt. e. Remove shorts made in steps a and b. f. Remove meter connections.	<i>DGMB</i>
3. Length Measurement Circuit, Circuit Board A4 a. Attach positive lead from digital voltmeter to terminal 10. Attach negative lead to terminal 22. b. Slowly rotate wheel of shaft encoder on length measurer until voltmeter reading is minimum. c. Adjust R8 until meter reads 0.000 ± 0.005 volt. d. Slowly rotate wheel of shaft encoder until voltmeter reading is maximum. e. Adjust R6 until meter reads 10.0 ± 0.005 volts. f. Remove meter connection.	<i>DGMB</i>
4. Insert Function Test Cartridge into computer.	<i>DGMB</i>
5. Preamp Offset, MILES Transducer Interface Assembly a. Allow a minimum of 2 hours after turning on the preamp power supply for warmup before proceeding with this test. b. Load calibration program (Function Test Cartridge file 1) by inputting the following sequence via the keyboard: LOAD 1 EXECUTE c. Press RUN and follow the programmed instructions. Record the specified data. 1) Programmed instructions: a) TERMINATE PREAMP INPUT. Terminate preamp input, terminate A and B of J7, with a 260 ± 5 ohm $\frac{1}{2}$ watt metal film resistor.	<i>DGMB</i>

Quality Assurance: _____

Date _____ 134

Transducer Test Set TS-3753/U+()

Calibration Data Sheet

Serial Number 002

Date 3-24-80

Sheet 5 of 7

CALIBRATION CHECK LIST	TECHNICIAN SIGN OFF																
<p>b) ALLOW PREAMP TO WARM UP FOR 2 HR. See step 5a.</p> <p>c) ADJUST R30 UNTIL BEEP, THEN STOP. This adjusts the preamp offset to less than .02 volts.</p> <p>d) VOLTMETER READING = ? The value of the offset voltage is displayed continually until the offset is less than 0.02 volts. Then the value of the offset voltage is printed out.</p> <p>e) GAIN CHECK. The next steps provide for measuring the preamplifier gain.</p> <p>f. ATTACH SCOPE PB TO OSC BD TER #4. ATTACH GROUND LEAD TO #22. Attach oscilloscope probe to terminal 4 of circuit board A2. Ground oscilloscope to terminal 22.</p> <p>g) ATTACH OTHER PROBE TIP TO JB1 #5. Attach the other oscilloscope probe to terminal TB1-5 in junction box JB1.</p> <p>h) REMOVE PREAMP TERMINATION. Remove 260 ohm preamp termination.</p> <p>i) FROM TERMINAL #4 OSC BOARD INPUT P-P SCOPE READING, app 20 V. Input value of the peak-peak voltage seen at terminal 4 of circuit board A2. Attach jumper from this terminal to TB-1 in JB1.</p> <p>j) FROM JB1 #5 INPUT VOLTAGE P-P, 10 V. Input value of the peak-peak voltage seen at terminal TB1-5 in junction box JB1. Remove jumper.</p> <p>k) PREAMP TEST COMPLETE. The preamplifier gain will be printed out; first in decibels then in absolute numbers.</p> <p>2) Record the printed data.</p> <table border="1"> <thead> <tr> <th></th> <th>MIN</th> <th>MAX</th> <th>TEST</th> </tr> </thead> <tbody> <tr> <td>Offset(V)</td> <td>---</td> <td>.02</td> <td>0.02</td> </tr> <tr> <td>Gain(db)</td> <td>103</td> <td>109</td> <td>104.5</td> </tr> <tr> <td>Gain</td> <td></td> <td></td> <td>167205</td> </tr> </tbody> </table> <p>d. Remove the oscilloscope probes.</p> <p>6. Earth Field Bias, Circuit Board A2.</p> <p>a. Load auto test program (Auto Test Cartridge, file 0) by inputting the following sequence via the keyboard:</p> <p>LOAD 0 EXECUTE</p>		MIN	MAX	TEST	Offset(V)	---	.02	0.02	Gain(db)	103	109	104.5	Gain			167205	<p>#1</p> <p>✓</p> <p>DGMB</p>
	MIN	MAX	TEST														
Offset(V)	---	.02	0.02														
Gain(db)	103	109	104.5														
Gain			167205														

Quality Assurance: _____

Date _____ 135

Transducer Test Set TS-3753/U+()

Calibration Data Sheet

Serial Number 002

Date 3-24-80

Sheet 6 of 7

CALIBRATION CHECK LIST	TECHNICIAN SIGN OFF
<p>b. Initiate auto test program. Input: RUN</p> <p>c. Choose manual test point selection and auto sequencing.</p> <p>d. Continue program until computer displays; READY FOR MAGNETIC TEST</p> <p>e. Wait approximately 5 seconds; then press STOP.</p> <p>f. Adjust RNC2 in JB4 to 15KΩ.</p> <p>g. Using a gauss meter such as the Bell 640 Incremental Gauss Meter, adjust R16 so that the gauss meter reads 0.25 gauss with the probe oriented in the same direction as the transducer at the center of field bias coil 1.</p> <p>h. Measure R16 and adjust R20 to the same value.</p> <p>i. Adjust RNC2 in JB4 to 17400Ω-0.5 R16.</p> <p>j. Repeat steps 6.g. through 6.i. until RNC2 and the magnetic field strength are both correct.</p> <p>7. Correlation Reference Circuits, Circuit Board A10.</p> <p>a. Load auto test program (Auto Test Cartridge, file 0) by inputting the following sequence via the keyboard:</p> <p style="text-align: center;">LOAD 0 EXECUTE</p> <p>b. Initiate auto test program. Input: RUN</p> <p>c. Choose auto sequencing.</p> <p>d. Continue program until computer displays: READY FOR P/S DATA</p> <p>e. Wait approximately 5 seconds; then press STOP.</p> <p>f. Measure force transducer output (VAF) at JB3 between TB2-5 and TB2-6.</p> <p>g. Disconnect lead from terminal TB1-5 in junction box JB-1.</p> <p>h. Short terminals X and R on circuit board A9.</p> <p>i. Adjust R2 on circuit board A9 until SVM reads 0.00±0.01 volt.</p> <p>j. Remove short between terminals X and R and place short between terminals X and Y.</p> <p>k. Attach oscilloscope probe to terminal Y. Ground oscilloscope to terminal R of circuit board A9.</p> <p>l. Record peak-to-peak voltage, V, of signal displayed on oscilloscope (approximately 10 volts).</p> <p>m. Adjust R5 on circuit board A9 until SVM reads (V/2)²/10. For example, if V=10, adjust R5 until meter reads 2.5 volts.</p>	<p style="text-align: center;">[Signature]</p>

Quality Assurance: _____

Date _____ 136

Transducer Test Set TS-3753/U+()

Calibration Data Sheet

Serial Number 003

Date 3-24-80

Sheet 7 of 7

CALIBRATION CHECK LIST	TECHNICIAN SIGN OFF
<p>n. Remove test leads and reattach lead to terminal TB1-5 in JB-1.</p> <p>o. Attach one oscilloscope probe to terminal 12 of circuit board A10. Ground the oscilloscope to terminal R.</p> <p>p. Adjust R5 on circuit board A10 until the peak-to-peak voltage indicated on the oscilloscope equals 11.28 million divided by (preamp gain X VAF(PP)). (See step 5, Preamp Offset).</p> <p>q. Adjust R4, shown in Figure 2.9, on circuit board A10 until:</p> $V_{SVM} = \frac{V_p \times 10^6}{G \times 0.355 \times V_{AF} \times 14.14}$ <p>where V_{SVM} = SVM reading V_p = Preamp Output V_{AF} = Force Transducer Output</p> <p>r. Remove oscilloscope connections.</p> <p>s. Wait at least 2 minutes for the correlation circuitry to stabilize.</p> <p>t. Press CONTINUE on the computer keyboard.</p> <p>u. Continue program until computer displays READY FOR MAGNETIC TEST.</p> <p>v. Wait approximately 5 seconds, and press STOP.</p> <p>w. Attach one oscilloscope probe to terminal 7 of circuit board A10. Ground the oscilloscope to terminal R.</p> <p>x. Adjust R21 on circuit board A10 until the peak-to-peak voltage indicated on the oscilloscope equals 2 million divided by the preamp gain.</p> <p>y. Adjust R20 on circuit board A10 until:</p> $V_{SVM} = \frac{V_p \times 10^6}{G \times 200 \times 0.1414}$ <p>z. Remove oscilloscope probe from terminal 1.</p> <p>a1. End of test.</p>	<p style="text-align: center;">✓</p> <p style="text-align: center;">B. J. M. B.</p>

Quality Assurance: _____

Date _____ 137

APPENDIX II

TEST DATA SHEETS

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 002

Date 3-24-80

Sheet 1 of 14

Para. 4.2.1 MANUAL SEQUENCING MANUAL TEST POINT SELECTION	TECHNICIAN SIGN OFF
1. Insert Automatic Test Cartridge into the computer and load the automatic test program by inputting the following sequence via the keyboard: LOAD 0 EXECUTE	<i>D.M.B.</i>
2. Press RUN and follow the programmed instructions.	<i>D.M.B.</i>
3. Choose manual sequencing and manual test point selection. The test points selected shall be 3, 4, 50 and 82.	<i>D.M.B.</i>
<p>4. Perform the following test. When the test requires data to be recorded, record the data in the technician sign-off column; if a qualitative judgment is required, such as for smoothness of operation, assess the equipment performance and sign if adequate. Explain any deficiencies.</p> <p>a. Software. Does the program operate correctly? Check accuracy of mean and standard deviation calculations.</p> <p>b. Sequence Control Smoothness. Is the transducer transport operation smooth? Check for "jerky" transducer movement, especially when starting or stopping.</p> <p>c. Test Time. Record the test time at each transposition tested.</p> <p style="text-align: center;">$t_i \leq 4$ minutes</p> <p>Record the time required to move the transducer from 3 to 4.</p> <p style="text-align: center;">$t_m \leq 1$ minute</p> <p>d. Rewind Time. Record the rewind time.</p> <p style="text-align: center;">$t_{rew} \leq 4$ minutes</p> <p>e. Positioning Accuracy. Record the transposition numbers tested. Record the distance from the center of the transposition to the center line of center clamp for each test location.</p>	<p><i>D.M.B.</i></p> <p>$t_3 = 3'04$</p> <p>$t_4 = 3'03$</p> <p>$t_{50} = 3'04$</p> <p>$t_{82} = 3'04$</p> <p>$t_{move} = 27 \text{ sec}$</p> <p>$t_{rew} = 3'14$</p> <p>$t_1 = 3$</p> <p>$t_2 = 4$</p> <p>$t_3 = 50$</p> <p>$t_4 = 82$ <i>D.M.B.</i></p>

Quality Assurance: _____

Date _____ 139

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 002

Date 3-24-80

Sheet 2 of 14

Para. 4.2.1 MANUAL SEQUENCE MANUAL TEST POINT SELECTION	TECHNICIAN SIGN OFF
<p> $t_1 = 3$ $t_2 = 4$ $t_3 = 50$ $t_4 = 82$ $d \leq \frac{1}{2}$ inch f. Display Clarity. Assess the quality of the display. Is it readable? g. Data Clarity. Assess the quality of the data printout. Is it readable? h. Inspect the MILES transducer for damages caused by the test. </p>	<p> $d_1 = \frac{1}{8}"$ $d_2 = \frac{1}{4}"$ $d_3 = \frac{3}{8}"$ $d_4 = \frac{1}{2}"$ </p> <p style="text-align: center;">↓</p> <p style="text-align: center;"><i>Dmb</i></p>

Quality Assurance: _____

Date _____ 140

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 002

Date 3-24-80

Sheet 3 of 14

Para. 4.2.2 MANUAL SEQUENCING AUTOMATIC TEST POINT SELECTION	TECHNICIAN SIGN OFF
1. Insert Automatic Test Cartridge into the computer and load the automatic test program by inputting the following sequence via the keyboard: LOAD 0 EXECUTE	<i>DMB</i>
2. Press RUN and follow the programmed instructions.	<i>DMB</i>
3. Choose manual sequencing and automatic test point selection. The test points selected shall be 10, 40, 60 and 80.	<i>DMB</i>
4. Perform the following test. When the test requires data to be recorded, record the data in the technician sign-off column; if a qualitative judgement is required, such as for smoothness of operation, assess the equipment performance and sign if adequate. Explain any deficiencies. a. Software. Does the program operate correctly? Check accuracy of mean and standard deviation calculations. b. Sequence Control Smoothness. Is the transducer transport operation smooth? Check for "jerky" transducer movement, especially when starting or stopping. c. Test Time. Record the test time at each transposition tested. $t_i \leq 4$ minutes d. Rewind Time. Record the rewind time. $t_{rew} \leq 4$ minutes e. Positioning Accuracy. Record the transposition numbers tested. Record the distance from the center of the transposition to the centerline of the center and clamp for each test location. $t_1 = 10$ $t_2 = 40$ $t_3 = 60$ $t_4 = 80$ $d \leq \frac{1}{2}$ inch	<p>$t_{10} = 3:03$ $t_{20} = 3:03$ $t_{60} = 3:03$ $t_{80} = 3:03$ $t_{rew} = 3:16$</p> <p>$t_1 = 10$ $t_2 = 40$ $t_3 = 60$ $t_4 = 80$ $d_1 = \frac{1}{4}$ $d_2 = \frac{1}{4}$ $d_3 = \frac{1}{4}$ $d_4 = \frac{1}{4}$</p> <p><i>DMB</i></p>

Quality Assurance: _____

Date _____ 141


Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 007

Date 3-24-80

Sheet 4 of 14

Para. 4.2.2 MANUAL SEQUENCING AUTOMATIC TEST POINT SELECTION	TECHNICIAN SIGN OFF
<p>f. Display Clarity. Assess the quality of the display. Is it readable?</p> <p>g. Data Clarity. Assess the quality of the data printout. Is it readable?</p> <p>h. Inspect the MILES transducer for damage caused by the test.</p>	

Quality Assurance: _____

Date _____ 142

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 007

Date 3-24-80

Sheet 5 of 14

Para. 4.2.3 AUTOMATIC SEQUENCING MANUAL TEST POINT SELECTION	TECHNICIAN SIGN OFF
1. Insert Automatic Test Cartridge into the computer and load the automatic test program by inputting the following sequence via the keyboard: LOAD 0 EXECUTE	
2. Press RUN and follow the programmed instructions.	
3. Choose automatic sequencing and manual test point selection. The test points selected shall be 3, 4, 50 and 82.	
<p>4. Perform the following test. When the test requires data to be recorded, record the data in the technician sign-off column; if a qualitative judgment is required, such as for smoothness of operation, assess the equipment performance and sign if adequate. Explain any deficiencies.</p> <p>a. Software. Does the program operate correctly? Check accuracy of mean and standard deviation calculations.</p> <p>b. Sequence Control Smoothness. Is the transducer transport operation smooth? Check for "jerky" transducer movement, especially when starting or stopping.</p> <p>c. Test Time. Record the test time at each transposition tested.</p> <p style="text-align: center;">$t_i \leq 4$ minutes</p> <p>Record the time required to move the transducer from 3 to 4.</p> <p style="text-align: center;">$t_m \leq 1$ minute</p> <p>d. Rewind time. Record the rewind time.</p> <p style="text-align: center;">$t_{rew} \leq 4$ minutes</p> <p>e. Positioning Accuracy. Record the transposition numbers tested. Record the distance from the center of the transposition to the centerline of the center clamp for each test location.</p>	<p>$t_3 = 3.03$ $t_4 = 3.03$ $t_{50} = 3.03$ $t_{82} = 3.03$</p> <p>$t_{move} = 28.50$</p> <p>$t_{rew} = 3.09$</p> <p>$t_1 = 3$ $t_2 = 4$ $t_3 = 5.0$ $t_4 = 8.2$ $d_1 = \frac{1}{4}$ $d_2 = \frac{1}{4}$</p> <p><i>[Signature]</i></p>

Quality Assurance: _____

Date _____ 143


Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 002

Date 3-24-80

Sheet 6 of 14

Para. 4.2.3 AUTOMATIC SEQUENCING MANUAL TEST POINT SELECTION	TECHNICIAN SIGN OFF
<p> $t_1 = 3$ $t_2 = 4$ $t_3 = 50$ $t_4 = 82$ $d \leq \frac{1}{2}$ inch f. Display Clarity. Assess the quality of the display. Is it readable? g. Data Clarity. Assess the quality of the display. Is it readable? h. Inspect the MILES transducer for damages caused by the test. </p>	<p> $d_3 \frac{1}{4}''$ $d_4 \frac{1}{4}''$  </p>

Quality Assurance: _____

Date _____ 144

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 002

Date 3-24-80

Sheet 7 of 14

Para. 4.2.4 AUTOMATIC SEQUENCING AUTOMATIC TEST POINT SELECTION	TECHNICIAN SIGN OFF
1. Insert Automatic Test Cartridge into the computer and load the automatic test program by inputting the following sequence via the keyboard: LOAD 0 EXECUTE	<i>D. M. B.</i>
2. Press RUN and follow the programmed instructions.	<i>D. M. B.</i>
3. Choose automatic sequencing and automatic test point selection. The test points selected shall be 10, 40, 60 and 80.	<i>D. M. B.</i>
4. Perform the following test. When the test requires data to be recorded, record the data in the technician sign-off column; if a qualitative judgment is required, such as for smoothness of operation, assess the equipment performance and sign if adequate. Explain any deficiencies. a. Software. Does the program operate correctly? Check accuracy of mean and standard deviation calculations. b. Sequence Control Smoothness. Is the transducer transport operation smooth. Check for "jerky" transducer movement, especially when starting or stopping. c. Test Time. Record the test time at each transposition tested. $t_i \leq 4$ minutes d. Rewind Time. Record the rewind time. $t_{rew} \leq 4$ minutes e. Positioning Accuracy. Record the transposition numbers tested. Record the distance from the center of the transposition to the centerline of the center clamp for each test location. $t_1 = 10$ $t_2 = 40$ $t_3 = 60$ $t_4 = 80$ $d \leq \frac{1}{2}$ inch	<p>$t_{10} = 3.03$ $t_{40} = 3.03$ $t_{60} = 3.03$ $t_{80} = 3.03$ $t_{rew} = 3.12$</p> <p>$t_1 = 10$ $t_2 = 40$ $t_3 = 60$ $t_4 = 80$ $d_1 = \frac{1}{4}"$ $d_2 = \frac{1}{4}"$ $d_3 = \frac{1}{4}"$ $d_4 = \frac{1}{4}"$</p> <p><i>D. M. B.</i></p>

Quality Assurance: _____

Date _____ 145

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 002

Date 3-24-80

Sheet 8 of 14

Para. 4.2.4 AUTOMATIC SEQUENCING AUTOMATIC TEST POINT SELECTION	TECHNICIAN SIGN OFF
<p>f. Display Clarity. Assess the quality of the display. Is it readable?</p> <p>g. Data Clarity. Assess the quality of the data printout. Is it readable?</p> <p>h. Inspect the MILES transducer for damages caused by the test.</p> <p>i. Limit Switch. Wrap a minimum of 10 transpositions around the takeup reel prior to restarting the automatic test sequence. Check for proper limit switch operation.</p> <p>j. Failure Mode. Disconnect the 1 Hz motor to cause a failure during P/S testing. Run another test. Choose automatic sequencing and automatic test point selection. After first transposition is tested, reconnect motor lead. Check the failure mode software and print out.</p>	<p style="text-align: center;">↓</p> <p style="text-align: center;"><i>limp</i></p>

Quality Assurance: _____

Date _____ 146


Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 002

Date 3-25-80

Sheet 9 of 14

Para. 4.3 MEASUREMENT ACCURACY	TECHNICIAN SIGN OFF
1. Insert Automatic Test Cartridge into the computer and load the function test program by inputting the following sequence via the keyboard: LOAD 0 EXECUTE	
2. Press RUN and follow the programmed instructions.	
3. Choose automatic sequencing.	
4. Measure the cable DCR and IR at the end of the test. Record the measured DCR and IR on the test printout.	
5. Repeat steps 2 through 4 until a total of 5 tests have been run.	

Quality Assurance: _____ 147


Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 002

Date 3-25-80

Sheet 10 of 14

Para. 4.3.1 DCR, IR						TECHNICIAN SIGN OFF
1. Record the measured and tested values of the DCR and IR from the Para. 4.3 test printouts.						
<u>DCR</u>			<u>IR</u>			
<u>Measured</u>	<u>Tested</u>	<u>Error</u>	<u>Measured</u>	<u>Tested</u>	<u>Error</u>	
252.9 Ω	253 Ω	0	718.888 Ω	719 Ω	—	
253.0 Ω	253 Ω	0	↓	↓	↓	
252.9 Ω	253 Ω	0				
252.9 Ω	253 Ω	0				
253.0 Ω	253 Ω	0				
<p>The difference between the tested and measured values shall not exceed $\pm 1\%$ of the measured value. This requirement does not apply to the IR reading if they exceed the range of the test instrument.</p>						

Quality Assurance: _____

Date _____ 148

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 002

Date 3-25-80

Sheet 11 of 14

Para. 4.3.2 MECHANICAL RESPONSE	TECHNICIAN SIGN OFF
<p>1. Record the values of the P/S means from the printouts obtained in the Para. 4.3 tests. Calculate the mean and standard deviation of these values.</p> $\mu_p = \sum_{i=1}^5 \frac{e_i}{5}$ $\sigma_p^2 = \sum_{i=1}^5 \frac{(e_i - \mu_p)^2}{5 - 1}$ $\sigma_p \leq 0.1 \mu_p$ <p>$\sigma_p \leq 1.11$</p> <p>$0.16 \leq 1.11$</p> <p>OK</p>	<p> $e_1 = 11.2$ $e_2 = 11.2$ $e_3 = 11.9$ $e_4 = 11.1$ $e_5 = 11.3$ </p> <p> $\mu_p = 11.1$ $\sigma_p = 0.16$ </p> <p><i>[Signature]</i></p>

Quality Assurance: _____

Date _____ 149

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 002

Date 3-25-80

Sheet 12 of 14

Para. 4.3.3 MAGNETIC RESPONSE	TECHNICIAN SIGN OFF
<p>1. Record the values of magnetic means from the print outs obtained in the Para. 4.3 tests. Calculate the mean and standard deviation of these values.</p> $\mu_m = \sum_{i=1}^5 \frac{e_i}{5}$ $\sigma_m^2 = \sum_{i=1}^5 \frac{(e_i - \mu_m)^2}{5 - 1}$ $\sigma_m \leq 0.1 \mu_m$	<p> $e_1 = .19$ $e_2 = .19$ $e_3 = .19$ $e_4 = .19$ $e_5 = .19$ </p> <p> $\mu_m = .19$ $\sigma_m = 0$ </p> <p><i>[Signature]</i></p>

Quality Assurance: _____

Date _____ 150

Transducer Test Set TS-3753/U+()

Test Data Sheet

Serial Number 002

Date 3-25-80

Sheet 13 of 14

Para. 4.3.4 DISTANCE BETWEEN TRANSPOSITIONS	TECHNICIAN SIGN OFF												
1. Modify the function test program to print out all the distance between transposition measurements.	<i>E-M/B</i>												
2. Run a complete test using the modified program.	<i>E-M/B</i>												
<p>3. Make actual measurements of the distance between transpositions at the specified locations. The measurement shall be made from the center line of the first transposition to the center line of the second transposition.</p> <table border="1"> <thead> <tr> <th></th> <th>Tested Value</th> <th>Measured Value</th> </tr> </thead> <tbody> <tr> <td>$d_3 = T_3 - T_4$</td> <td>43.0</td> <td>43 "</td> </tr> <tr> <td>$d_{10} = T_{10} - T_{11}$</td> <td>43.9</td> <td>43 "</td> </tr> <tr> <td>$d_{75} = T_{75} - T_{76}$</td> <td>43.4</td> <td>43 "</td> </tr> </tbody> </table> <p>The tested value and the measured value must agree within $\pm 1\%$ of the measured value.</p>		Tested Value	Measured Value	$d_3 = T_3 - T_4$	43.0	43 "	$d_{10} = T_{10} - T_{11}$	43.9	43 "	$d_{75} = T_{75} - T_{76}$	43.4	43 "	<i>E-M/B</i>
	Tested Value	Measured Value											
$d_3 = T_3 - T_4$	43.0	43 "											
$d_{10} = T_{10} - T_{11}$	43.9	43 "											
$d_{75} = T_{75} - T_{76}$	43.4	43 "											
4. Calculate the mean and standard deviation (see para. 4.3.2 tests) of the distance between transposition measurements. The results must agree with the printout results.	<i>E-M/B</i>												

Quality Assurance: _____

Date _____ 151

Transducer Test Set TS-3753/U+()

Quality Data Sheet

Serial Number 002

Date 3-26-80

Sheet 14 of 14

Para. 5.2 NAMEPLATES AND PRODUCT MARKING	TECHNICIAN SIGN OFF
<p>1. Indicate conformance with MIL-STD-130.</p> <p>Quality Assurance: <u>X Martin</u></p> <p>Date: <u>3-26-80</u></p>	
<p>Para. 5.3 WORKMANSHIP</p> <p>1. Indicate conformance with the Honeywell Sea, Air and Ground Workmanship Standard, UED 23036.</p> <p>Quality Assurance: <u>X Martin</u></p> <p>Date: <u>3-26-80</u></p>	

Quality Assurance: _____

Date _____ 152

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #2/4.2.1

OCR = 253 Q
IR = 19000000 Q

CABLE TRANS.# 3
PRESSURE SENS.
12.1 uV/lb
MAGNETIC SENS.
-0.19 uV/gamma

CABLE TRANS.# 4
PRESSURE SENS.
-13.6 uV/lb
MAGNETIC SENS.
0.19 uV/gamma

CABLE TRANS.#50
PRESSURE SENS.
-9.9 uV/lb
MAGNETIC SENS.
0.19 uV/gamma

CABLE TRANS.#82
PRESSURE SENS.
-11.4 uV/lb
MAGNETIC SENS.
0.19 uV/gamma

FINAL POSITION
OCR = 253 Q
IR = 19000000 Q

P/S DATA RESULTS
ps= 11.7uV/lb
ms= 1.5uV/lb

MAG DATA RESULTS
pm= 0.19uV/gamma
sm= 0.00uV/gamma

LENGTH RESULTS
pd= 43.0inches
sd= 0.2inches

TRANSPOSITIONS
TOTAL= 86.00

TRANSDUCER ##
PASSED ###
#####

Unit #002 Manual Sequencing,
Manual Test Point Selection
Paragraph 4.2.1

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #2/4.2.2

OCR = 253 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-11.2 $\mu\text{V/lb}$
MAGNETIC SENS.
0.21 $\mu\text{V/gamma}$

CABLE TRANS.#40
PRESSURE SENS.
-10.6 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.0 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.4 $\mu\text{V/lb}$
MAGNETIC SENS.
0.20 $\mu\text{V/gamma}$

FINAL POSITION
OCR = 253 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 11.0 $\mu\text{V/lb}$
 σs = 1.0 $\mu\text{V/lb}$

MAG DATA RESULTS
 μm = 0.20 $\mu\text{V/gamma}$
 σm = 0.01 $\mu\text{V/gamma}$

LENGTH RESULTS
 μd = 43.0 inches
 σd = 0.2 inches

TRANSPOSITIONS
TOTAL = 86.00

TRANSDUCER ##
PASSED ####
#####

Unit #002 Manual Sequencing,
Automatic Test Point Selection
Paragraph 4.2.2

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #2/4.2.3

:::::::::::::
OCR = 254 Q
IR = 19000000 Q

CABLE TRANS.# 3
PRESSURE SENS.
11.8 uV/lb
MAGNETIC SENS.
-0.19 uV/gamma

CABLE TRANS.# 4
PRESSURE SENS.
-13.6 uV/lb
MAGNETIC SENS.
0.19 uV/gamma

CABLE TRANS.#50
PRESSURE SENS.
-10.0 uV/lb
MAGNETIC SENS.
0.19 uV/gamma

CABLE TRANS.#82
PRESSURE SENS.
-11.4 uV/lb
MAGNETIC SENS.
0.20 uV/gamma

FINAL POSITION
OCR = 253 Q
IR = 19000000 Q

F/S DATA RESULTS
us = 11.7uV/lb
os = 1.5uV/lb

MAG DATA RESULTS
um = 0.19uV/gamma
om = 0.00uV/gamma

LENGTH RESULTS
ud = 43.0inches
od = 0.2inches

TRANSPPOSITIONS
TOTAL= 86.00

TRANSDUCER ##
PASSED ###

Unit #002 Automatic Sequencing,
Manual Test Point Selection
Paragraph 4.2.3

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80
SERIAL #2/4.2.4

.....
DCR = 253 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-11.4 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#40
PRESSURE SENS.
-10.1 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.1 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.4 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

FINAL POSITION
DCR = 253 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 11.00 $\mu\text{V/lb}$
 σs = 1.10 $\mu\text{V/lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V/gamma}$
 σm = 0.00 $\mu\text{V/gamma}$

LENGTH RESULTS
 μd = 43.0 inches
 σd = 0.2 inches

TRANSPPOSITIONS
TOTAL = 86.00

TRANSDUCER ##
PASSED ###

Unit #002 Automatic Sequencing,
Automatic Test Point Selection
Paragraph 4.2.4

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #002

OCR = 253 0
IR = 19000000 0

CABLE TRANS.#10
BAD P/S SEN.!!
MAGNETIC SENS.
0.19 uv/30mm0

CABLE TRANS.#40
PRESSURE SENS.
-10.2 uv/1b
MAGNETIC SENS.
0.19 uv/30mm0

CABLE TRANS.#60
PRESSURE SENS.
-10.2 uv/1b
MAGNETIC SENS.
0.19 uv/30mm0

CABLE TRANS.#80
PRESSURE SENS.
-12.8 uv/1b
MAGNETIC SENS.
0.19 uv/30mm0

FINAL POSITION
OCR = 253 0
IR = 19000000 0

P/S DATA RESULTS
us= 8.3uv/1b
os= 5.7uv/1b

MAG DATA RESULTS
um= 0.19uv/30mm0
om= 0.00uv/30mm0

LENGTH RESULTS
ud= 43.0inches
od= 0.2inches

TRANSPPOSITIONS
TOTAL= 86.00

TRANSDUCER ##
FAILED ####
#####

TOTAL DEFECTS
2.00

DEFECT LIST
BAD P/S AT TRP 10.00
BAD P/S MEAN
HIGH P/S STD DV

Unit #002 Automatic Sequencing,
Automatic Test Point Selection, Failure Mode
Paragraph 4.2.4.J

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #2/4.3/1

:::::::::::::
DCR = 253 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-11.5 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.19 $\mu\text{V}/\text{gmma}$

CABLE TRANS.#40
PRESSURE SENS.
-10.5 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.19 $\mu\text{V}/\text{gmma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.1 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.19 $\mu\text{V}/\text{gmma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.8 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.19 $\mu\text{V}/\text{gmma}$

FINAL POSITION
DCR = 253 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 11.2 $\mu\text{V}/\text{lb}$
 σs = 1.2 $\mu\text{V}/\text{lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V}/\text{gmma}$
 σm = 0.00 $\mu\text{V}/\text{gmma}$

LENGTH RESULTS
 μd = 43.0 inches
 σd = 0.2 inches

TRANSPOSITIONS
TOTAL = 86.00

TRANSDUCER ##
PASSED ####
#####

PCR 252.9 Ω
IR > 18.888 M Ω

Unit #002 Measurement Accuracy
Paragraph 4.3 Run #1

MILES TRANSDUCER
AUTOMATIC TEST

3/25/80

SERIAL #244.372

:::::::::::::
DCR = 253 0
IR = 19000000 0

CABLE TRANS.#10
PRESSURE SENS.
-11.4 00/1b
MAGNETIC SENS.
0.19 00/90mm0

CABLE TRANS.#40
PRESSURE SENS.
-10.0 00/1b
MAGNETIC SENS.
0.19 00/90mm0

CABLE TRANS.#60
PRESSURE SENS.
-10.4 00/1b
MAGNETIC SENS.
0.19 00/90mm0

CABLE TRANS.#80
PRESSURE SENS.
-12.8 00/1b
MAGNETIC SENS.
0.19 00/90mm0

FINAL POSITION
DCR = 253 0
IR = 19000000 0

P/S DATA RESULTS
us= 11.200/1b
os= 1.200/1b

MAG DATA RESULTS
um= 0.1900/90mm0
om= 0.0000/90mm0

LENGTH RESULTS
ud= 43.0inches
od= 0.2inches

TRANSPPOSITIONS
TOTAL= 86.00

TRANSDUCER ##
PASSED ####
#####

DCR 253 0 ~
IR > 18.888m-2

Unit #002 Measurement Accuracy
Paragraph 4.3 Run #2

MILES TRANSDUCER
AUTOMATIC TEST

3/25/80

SERIAL #2/4.3/3

:::::::::::::
DCR = 253 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-11.6 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.19 $\mu\text{V}/\text{gmm}$

CABLE TRANS.#40
PRESSURE SENS.
-9.8 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.19 $\mu\text{V}/\text{gmm}$

CABLE TRANS.#60
PRESSURE SENS.
-10.1 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.19 $\mu\text{V}/\text{gmm}$

CABLE TRANS.#80
PRESSURE SENS.
-12.2 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.19 $\mu\text{V}/\text{gmm}$

FINAL POSITION
DCR = 253 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 10.90 $\mu\text{V}/\text{lb}$
 σs = 1.10 $\mu\text{V}/\text{lb}$

MAG DATA RESULTS
 μm = 0.1900 $\mu\text{V}/\text{gmm}$
 σm = 0.0000 $\mu\text{V}/\text{gmm}$

LENGTH RESULTS
 μd = 43.0 inches
 σd = 0.2 inches

TRANSPPOSITIONS
TOTAL = 86.00

TRANSDUCER ##
PASSED ###
#####

DCR 252.9 Ω

IR > 18.888 μm

Unit #002 Measurement Accuracy
Paragraph 4.3 Run #3

MILES TRANSDUCER
AUTOMATIC TEST

3/25/80

SERIAL #2/4.3/4

:::::::::::::
DCR = 253 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-11.1 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.19 $\mu\text{V}/\text{gammma}$

CABLE TRANS.#40
PRESSURE SENS.
-10.4 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.19 $\mu\text{V}/\text{gammma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.4 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.19 $\mu\text{V}/\text{gammma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.3 $\mu\text{V}/\text{lb}$
MAGNETIC SENS.
0.20 $\mu\text{V}/\text{gammma}$

FINAL POSITION
DCR = 253 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 11.1 $\mu\text{V}/\text{lb}$
 σs = 0.9 $\mu\text{V}/\text{lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V}/\text{gammma}$
 σm = 0.00 $\mu\text{V}/\text{gammma}$

LENGTH RESULTS
 μd = 43.0 inches
 σd = 0.2 inches

TRANSPOSITIONS
TOTAL = 86.00

TRANSDUCER ##
PASSED ####
#####

DCR 252.9 Ω
IR > 18.888 M Ω

Unit #002 Measurement Accuracy
Paragraph 4.3 Run #4

MILES TRANSDUCER
AUTOMATIC TEST

3/25/80

SERIAL #2/4.3/5

:::::::::::::
DCR = 253 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-11.5 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#40
PRESSURE SENS.
-10.5 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.6 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.5 $\mu\text{V/lb}$
MAGNETIC SENS.
0.20 $\mu\text{V/gamma}$

FINAL POSITION
DCR = 253 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 $\mu\text{s} = 11.3\mu\text{V/lb}$
 $\sigma\text{s} = 0.9\mu\text{V/lb}$

MAG DATA RESULTS
 $\mu\text{m} = 0.19\mu\text{V/gamma}$
 $\sigma\text{m} = 0.00\mu\text{V/gamma}$

LENGTH RESULTS
 $\mu\text{d} = 43.0\text{inches}$
 $\sigma\text{d} = 0.2\text{inches}$

TRANSPOSITIONS
TOTAL = 86.00

\$\$ TRANSDUCER \$\$
PASSED ####
#####

DCR 253.0 Ω
IR > 18.588M Ω

Unit #002 Measurement Accuracy
Paragraph 4.3 Run #5

MILES TRANSDUCER
FUNCTIONAL TEST

P/S mean 13.00
P/S mean L 5.00
P/S sd L 10.00
MAG mean 0.20
MAG mean L 0.05
MAG sd L 0.10
Tn Dt mean 43.00
Tn mean L 1.00
Tn sd L 2.00

3/25/80

SERIAL #2/4.3.4

:::::::::::::
DCR = 253 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-11.7 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#40
PRESSURE SENS.
-10.2 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#60
PRESSURE SENS.
-9.9 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#80
PRESSURE SENS.
-12.0 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

FINAL POSITION
DCR = 253 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 μs = 10.9 $\mu\text{V/lb}$
 σs = 1.1 $\mu\text{V/lb}$

MAG DATA RESULTS
 μm = 0.19 $\mu\text{V/gamma}$
 σm = 0.00 $\mu\text{V/gamma}$

LENGTH RESULTS
 μd = 43.0 inches
 σd = 0.2 inches

TRANSPPOSITIONS
TOTAL= 86.00

TRANSDUCER ##
PASSED ###
#####

Unit #002 Distance Between Transpositions
Functional Test (Sheet 1)
Paragraph 4.3.4

TRP# 1L= 43.2	TRP# 26L= 43.0
TRP# 2L= 43.0	TRP# 27L= 43.0
TRP# 3L= 43.0	TRP# 28L= 42.9
TRP# 4L= 43.1	TRP# 29L= 43.1
TRP# 5L= 42.9	TRP# 30L= 43.1
TRP# 6L= 42.9	TRP# 31L= 43.0
TRP# 7L= 42.9	TRP# 32L= 43.1
TRP# 8L= 43.3	TRP# 33L= 42.9
TRP# 9L= 42.9	TRP# 34L= 42.8
TRP# 10L= 42.9	TRP# 35L= 43.0
TRP# 11L= 43.1	TRP# 36L= 42.9
TRP# 12L= 43.0	TRP# 37L= 42.5
TRP# 13L= 43.0	TRP# 38L= 42.8
TRP# 14L= 43.2	TRP# 39L= 42.8
TRP# 15L= 43.0	TRP# 40L= 42.6
TRP# 16L= 43.0	TRP# 41L= 42.4
TRP# 17L= 42.9	TRP# 42L= 43.1
TRP# 18L= 43.0	TRP# 43L= 42.8
TRP# 19L= 43.0	TRP# 44L= 43.1
TRP# 20L= 43.2	TRP# 45L= 43.3
TRP# 21L= 42.9	TRP# 46L= 43.1
TRP# 22L= 43.1	TRP# 47L= 42.9
TRP# 23L= 42.9	TRP# 48L= 43.1
TRP# 24L= 43.0	TRP# 49L= 43.1
TRP# 25L= 43.0	TRP# 50L= 43.1

Unit #002 Distance Between Transpositions
 Functional Test (Sheet 2)
 Paragraph 4.3.4

TRP# 51L= 43.2	
TRP# 52L= 43.1	
TRP# 53L= 43.1	
TRP# 54L= 43.0	
TRP# 55L= 43.1	
TRP# 56L= 43.0	
TRP# 57L= 42.5	TRP# 76L= 43.2
TRP# 58L= 43.2	TRP# 77L= 42.4
TRP# 59L= 43.0	TRP# 78L= 43.3
TRP# 60L= 43.2	TRP# 79L= 42.9
TRP# 61L= 43.0	TRP# 80L= 43.3
TRP# 62L= 43.1	TRP# 81L= 42.8
TRP# 63L= 43.3	TRP# 82L= 43.4
TRP# 64L= 43.0	TRP# 83L= 42.6
TRP# 65L= 43.0	
TRP# 66L= 43.1	
TRP# 67L= 43.0	
TRP# 68L= 43.1	
TRP# 69L= 42.9	
TRP# 70L= 43.3	
TRP# 71L= 43.1	
TRP# 72L= 43.1	
TRP# 73L= 42.8	
TRP# 74L= 43.4	
TRP# 75L= 42.9	

Unit #002 Distance Between Transpositions
Functional Test (Sheet 3)
Paragraph 4.3.4

MILES TRANSDUCER
AUTOMATIC TEST

3/24/80

SERIAL #002

:::::::::::::
DCR = 253 Ω
IR = 19000000 Ω

*Limit
Switch
OK*

Unit #002 Limit Switch Test
Paragraph 4.2.4.i

MILES TRANSDUCER
AUTOMATIC TEST

3/25/80

SERIAL #002

:::::::::::::
DCR = 254 Ω
IR = 19000000 Ω

CABLE TRANS.#10
PRESSURE SENS.
-12.0 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#40
PRESSURE SENS.
-11.0 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#60
PRESSURE SENS.
-10.7 $\mu\text{V/lb}$
MAGNETIC SENS.
0.19 $\mu\text{V/gamma}$

CABLE TRANS.#80
PRESSURE SENS.
-11.6 $\mu\text{V/lb}$
MAGNETIC SENS.
0.20 $\mu\text{V/gamma}$

FINAL POSITION
DCR = 254 Ω
IR = 19000000 Ω

P/S DATA RESULTS
 $\mu\text{s} = 11.3\mu\text{V/lb}$
 $\sigma\text{s} = 0.6\mu\text{V/lb}$

MAG DATA RESULTS
 $\mu\text{m} = 0.19\mu\text{V/gamma}$
 $\sigma\text{m} = 0.00\mu\text{V/gamma}$

LENGTH RESULTS
 $\mu\text{d} = 43.0\text{inches}$
 $\sigma\text{d} = 0.2\text{inches}$

TRANSPOSITIONS
TOTAL = 86.00

TRANSDUCER ##
PASSED ####
#####

Unit #002 Witness Test



*MISSION
of
Rome Air Development Center*

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ED
8